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HAYWARD HILLS AREA WILDLIFE STUDY



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HAYWARD PLANNING DEPARTMENT · DECEMBER, 1977

HAYWARD HILLS AREA WILDLIFE STUDY

Wildlife conservation -- California -- Hayward

HAYWARD PLANNING DEPARTMENT · DECEMBER, 1977

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WILDLIFE SURVEY PERIOD: June 1, 1977 - September 1, 1977.

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CHAPTER I - INTRODUCTION

A study of the wildlife of an area differs greatly from botanical or geological studies in that trees and rocks are rather permanent fixtures which are easily visible in a habitat whereas the observation of animal species is, at best, a rather sporadic affair. The reasons for this contrast are several. First of all, many animal species are extremely seasonal in their utilization of a habitat. Many salamander species, for example, are very numerous during the cool, rainy months and at this time may be observed very easily. However, in late spring these amphibians seek out deep, subsoil retreats where they remain until the next rainy season, and during the dry season it takes a major excavation to locate these animals. Another good example of highly variable abundance is the migrating birds. What may be a very common form or song in the brush and woodland one month is often completely absent the next. Finally, many animals, particularly the mammals, are nocturnal and very secretive. Many times species of bats, small rodents and insectivores are never observed by the vast majority of human inhabitants in an area. Large mammals, such as bobcat and mountain lion, are equally elusive and work very hard at not being seen.

The preceding comments are made to remind the reader that such quantitative data as numbers of organisms per acre which can be very exact when dealing with trees or shrubs are at best only fair estimates when working with animals. In addition, this study covered only four months of the year: June to September, 1977. Also, the year 1977 will no doubt go down in the record books as one of the driest ever for Central California, and the field observations made for this study are far from representative for a normal year in this area. To cope with this problem, this report therefore includes field data collected in the study area over the past eight years, as well as that obtained in 1977. In this manner, the analysis of animals of the Hayward Hills and their interrelationships to the habitat and each other will be far more representative of the normal yearly picture.

Many of the animal species discussed in this report are closely associated with a specific plant community, and it therefore appears useful to initially define for the reader these botanical areas. The most general reference throughout the report with respect to plant communities is simply that of north- or south-facing slopes. To one who may be totally unfamiliar with the East Bay hills, this is certainly a rather meaningless designation. However, one needs only to hike but one hilltop to note that the north-facing slopes

are densely wooded, while the south-facing slopes are primarily grassland with scattered patches of northern coastal scrub or coast live oak. Because many animal species thrive only in densely wooded habitat or open grassland, this reference to north and south slopes is extremely useful.

It is also useful to subdivide the wooded areas into riparian woodland and broad sclerophyll forest. The riparian woodland occurs at the bottom of the canyons and extends up the walls on both the north and south face for a short distance. This community maintains the highest soil moisture of any and is many times associated with a temporary or permanent stream. Dominant trees include big leaf maple, California laurel or bay, sycamore, and willow. In addition, it contains a rich understory of mosses, ferns, California wild blackberry, poison oak, canyon gooseberry, snowberry, and coffeeberry to name a few. The broad sclerophyll forest also contains California laurel and big leaf maple but also adds coast live oak, buckeye, and some madrone. The understory may also contain some shrubs found also in the riparian woodland but in much lesser densities.

The grassland community dominates the higher portions of the south-facing slopes and is composed mainly of wild oat, brome grasses, Italian rye grass, foxtail, and perennial needlegrass. In addition, patches of forbs such as poison hemlock, sweet fennel, cow parsnip, curly dock, yerba buena, and false Solomon's seal may be found. Many of these are very valuable sources of seeds for animal food. The occasional patches of northern coastal scrub are also an important food source and are composed primarily of coyote bush and California sagebrush. In addition, the northern coastal scrub community and scattered patches of coast live oak provide valuable cover for many of the animals which live in the otherwise open grassland.

The major portion of this report will be devoted to a systematic coverage of all vertebrate species in the Hayward Hills area and will follow a descending taxonomic order, starting with mammals and ending with fish. For each species, the areas covered will be: habitat requirements, reproductive biology, relative abundance, and compatibility with humans. A second section will illustrate a few of the many food chains or webs which exist among these species and show how the removal of any one link in such food chains effects all other involved species. This latter section will also comment on those land development or disturbance practices which are especially harmful to numerous wildlife species.

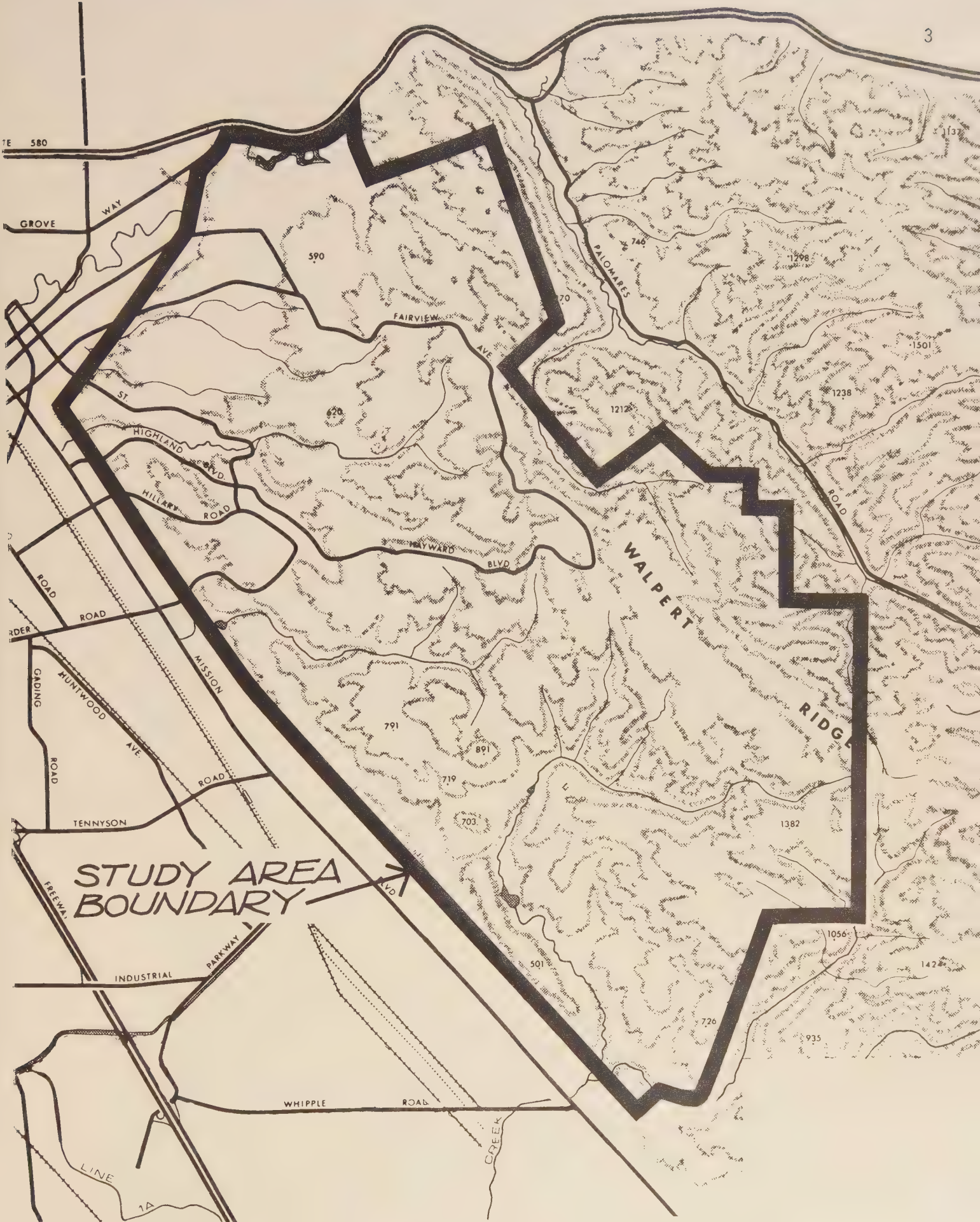


Figure 1
Study Area



PLATE I

BLACK-TAILED DEER

(Odocoileus hemionus columbianus)

CHAPTER II-THE MAMMALS (Class *Mammalia*)

NON-CARNIVOROUS MAMMALS

BLACK-TAILED DEER (*Odocoileus hemionus columbiabus*)

Perhaps no other species of native mammal inspires so much attention and interest as deer. Our local subspecies of mule deer, the black-tailed deer, is the only remaining wild ungulate or hooved mammal in this area and therefore occupies a key position in the vertebrate community.

Habitat Requirements. In the Hayward Hills, black-tail deer are most frequently found in areas of coastal scrub or near the border of grassland and woodland. They are browsers, which means they eat the leaves and twigs of woody plants and forbs as opposed to grasses. Deer food is referred to as browse and may vary greatly from area to area. Longhurst, 1968, describes the process whereby the rumen bacteria of the black-tail deer and other ungulates are inhibited by volatile substances in certain plant species. Deer are apparently able to detect these plants using their sense of smell, and therefore a number of highly nutritious browse species are evidently considered unpalatable by deer. This is a rather important fact to keep in mind when studying deer habitat, because at first glance there appears to be an overabundance of available food. It is not until one closely observes that only a few plant species have been rigorously pruned back that a true preferred browse list can be made. In this area, the list includes coast live oak, willow, coyote bush, snowberry and toyon. In addition, there were observations of deer feeding on small forbs in the grassland. This is probably due to the lack of good terminal growth in the preferred browse species during this most severe drought year. Black-tail deer also eat a good deal of new spring grass growth in this area, but as soon as the oat, rye and other grass species grow tall and begin to set seed, they seem to ignore them. The importance of early spring grass in the diet of deer is poorly documented in the literature, but perhaps the early spring grass serves as an interim source of nourishment while the preferred browse species begin their spring growth.

Reproductive Biology. Female black-tail deer breed at 1.5 years of age (Halford & Alldredge, 1975). Fawns are born in this area as early as late February, but March and April fawns are more common. A yearling doe normally has one fawn, but from then on twins or even triplets may occur if the range is lush. Numerous studies of both the mule and the eastern white-tailed deer have demonstrated that the quality and abundance of the preferred browse is the prime factor in determining whether singles or twins will be born. If the food is very poor and scarce, a second or third early embryo is apparently aborted. Of the eleven does with fawns observed during the course of this study all had single fawns. Such observations lend strong support to the idea that the deer range in the Hayward Hills is at an all time low during this most severe drought year.

Deer skulls and jaws recovered in the field may be accurately aged by the pattern of tooth replacement and wear. No skull or jaw over ten years of age was found during this study. This probably represents the average longevity for the black-tail deer in this area.

Relative Abundance. Any sort of even close estimate of the number of deer in the study area is nearly impossible in a limited study such as this. This is due to a number of reasons. First of all, deer do not normally congregate to feed, but instead usually are scattered throughout the habitat. Secondly, they normally travel and feed from narrow trails through the coastal scrub and riparian woodland where, in each case, they are very hard to observe. Finally, they are primarily nocturnal and bed down in thick brush during the day. In all these aspects, they are no different than many of the small mammals in the area except in their size and mobility, and therein lies the problem. It is relatively easy to conduct a "mark and recapture" study on mice to determine their approximate population size, but a similar study on deer is a most difficult undertaking. This also holds true for the majority of larger mammals in this study. It is a fair assumption, however, that deer in the Hayward Hills area continuously stay at or slightly above the carrying capacity of the range. This is due to the relative lack of any really serious predation. Perhaps the automobile is the main eliminator, followed by domestic dog packs and the occasional poacher. Coyotes perhaps take a few fawns each season but are normally incapable of handling a full grown deer. An occasional wandering mountain lion no doubt also figures into the annual kill, but again the take must be indeed small. Thus, by first removing most of the natural predators and then forbidding his own hunting, man has created a situation in this area whereby deer numbers are regulated by low birth rate, starvation and disease rather than by predation.

Compatibility with Humans. Because of decades without legal hunting in the study area, natural selection has apparently been relaxed in favor of less-wary deer. The result is now a population of deer which normally do not run at the distant sight of people and many times permit very close approach. In addition, deer will invade domestic plant communities to feed, especially during the late summer and fall months when the range is at its poorest level. Black-tail deer are occasionally seen late at night on the southern lawns of the campus of California State University, Hayward. These animals move across Harder Road from areas of coastal scrub, which normally provides their food. Far more frequent are visitations to gardens in yards which border on natural land. Thus, the largest wild animal in the hills area is one of the easiest species to observe.

The overall public reaction to deer is most favorable. People simply like to view deer, and most residences surveyed for this study indicated that the observable presence of deer near their home adds greatly to the overall satisfaction of their residence. This outlook has increased greatly during the last decade with the greater overall ecological awareness on the part of the public, and such phrases as "see deer from your window" are occasionally seen in local real estate advertising.

The primary human activity which continues to work against large deer populations in the Hayward Hills is the reduction of wild land pockets to a size less than the home range of one deer and with no interconnections to other wild plots. Home range is defined as that area in which an animal lives throughout its life. It may vary in size from year to year or season to season, but an average of this variability will give a fairly good working estimate for an area. Home range in deer may only be adequately determined by the telemetric tracking of individual animals, and to date, no such study has been undertaken in coastal California. A graduate student at California State University, Hayward, is beginning such a study in Garin Regional Park in the Fall of 1977, and a report of his findings will later be submitted as an amendment to this report. A very rough estimate at this time is about 100 acres per deer, bearing in mind that home ranges will often overlap and that somewhere in that range the deer must have drinking water. Corridors between wild areas should not only be of adequate width, but should also contain the proper plant association. A thickly wooded, north-facing slope, for instance, is normally not penetrated by traveling deer, whereas riparian canyon bottom or better yet, coastal scrub, is ideal. A full discussion of wildlife corridors is presented later in this report.

The other human activities which work to reduce deer populations have already been mentioned. Automobiles, poachers, and dogs, in one sense, tend to substitute for the human-caused lack of natural predators. Of these, the auto remains a small, constant factor and poaching appears to be very sporadic. Dogs and dog packs, however, pose a rising threat to deer. As human populations increase in a former wildlife area, the daily presence of large numbers of dogs in prime deer feeding areas could greatly diminish the use of this range. A further discussion of dogs and their impact on the environment will also be presented later in the report.

In summary, not only does the public view deer as the single most important indicator of a persisting wilderness state, but management for deer normally insures the preservation of countless other species, as well. For these reasons, the black-tailed deer is stressed and referred to more than any other species in this report.

BLACK-TAILED JACKRABBIT (*Lepus californicus*)

Habitat Requirements. The black-tailed jackrabbit is the second largest herbivore in the Hayward Hills wildlife community. It inhabits areas of sparse coastal scrub and open grassland. Its main line of defense against predators is running full speed across large open areas. For this reason, populations always tend to be higher in grazed pasture land than in mature ungrazed grassland, since the long grass hinders running. Here, then, is the first of several mammal species which have, no doubt, increased in number through the human activity of stock grazing. Their other form of defense is simply to crouch down in small depressions in the middle of pasture land. Their protective coloration blends in so well with the surrounding dried grass and dirt that most humans or would-be predators pass by without a notice. Like the deer, the jackrabbit is primarily a browser and eats a variety of woody shrubs and forbs, but also takes grass in the young, growing stage. Overpopulations of jackrabbits can be a very detrimental force upon the plant community, as they can easily consume all new seedling trees and shrubs in the area. Unlike deer, the jackrabbit does not have to drink water daily, but instead gets by on the preformed water in the green plant food which it eats. This is true for the majority of smaller herbivorous mammals that inhabit the xeric south-facing slopes in the hill area. They are nocturnal in their foraging and spend the day crouched in their depressions.

Reproductive Biology. Black-tailed jackrabbits breed year around in this area, although the highest reproduction appears to be during the first half of the year. Females begin breeding at one year of age and may have several litters of from one to six young per year. Unlike other North American rabbit species, jackrabbit young are very precocial and spend very little time at the birth site or nest area. In this way, they escape much of the predation experienced in other rabbit species with long nest stages. During the first month of this study, several sets of two or three young with a mother were observed in the grazed pastureland bordering Fairview Boulevard, just after sunset. The young apparently accompany the mother on her nightly feeding rounds and no doubt nurse during that time.

Relative Abundance. Like deer, no accurate estimate of abundance and home range can be made without a "mark and recapture" or telemetry study. Jackrabbits are very difficult to trap, and thus such studies are lacking in the literature. In flat, open areas, fairly accurate direct counts can be made. Pontrelli, 1966, recorded densities of nearly one animal per acre at the Oakland Airport. However, this was under near-ideal range conditions. In the hills area, densities in prime habitat probably do not exceed one per five to ten acres.

Compatibility with Humans. As very apparent by the aforementioned Oakland Airport study, the black-tailed jack is not easily disturbed by human activity, even the continuous roar of jet planes a few meters overhead. Their preference for moderately grazed pastures bordered by some scrub growth, and their successful forms of defense, have resulted in good populations throughout the Coast Range. Dogs and cats appear to take mostly young jackrabbits which have not as yet attained the full running speed of the adult. The auto seems to kill a rather large number of jackrabbits compared to other mammal species. This species shows far more confusion in the beam of on-coming headlights than most mammals, and often dashes back into the path of a vehicle once it has successfully crossed a road. Both young and adult are an important link in the grassland food chain to be discussed later. Rabbits do carry tularemia and also harbor fleas which may transmit plague. The handling of dead animals, especially ones with open wounds, can be potentially hazardous.

BRUSH RABBIT (*Sylvilagus bachmani*)

Habitat Requirements. Unlike its much larger relative, the black-tailed jackrabbit, the brush rabbit is a mammal of the dense thicket, rarely venturing far from the protective edge of the brush. Its small size, which is about half that of a domestic rabbit, is not conducive to speed, and it instead seeks protection in the dense vegetative cover of the riparian woodland and the coastal scrub. It is also more of a cambian and leaf feeder than the jackrabbit. Its density seems to be dependent on the amount of edge area of brush stands, since it is here that the majority of low, green growth occurs. Thus, a large stand of coastal scrub riddled with wide horse trails is a much more productive habitat for the brush rabbit than a solid stand.

Reproductive Biology. The brush rabbit breeds from January to June. Females have two to four litters per season with two to five young per litter. The young are completely helpless at birth and must remain in the nest for several weeks before venturing out in a part-grown state. Thus, mortality due to small ground predators such as the gopher snake is rather high. However, the excellent overhead protection of the brush cover negates nearly all avian predation.

Relative Abundance. During normal rainfall years, we have surveyed brush rabbit populations in the Hayward Hills area at one to two animals per acre. Like most mammals, they are greatly affected by the lack of new green vegetative growth, and this summer we estimate the population to be no more than two to three brush rabbits per five acres. These counts were made by quietly encircling areas of prime habitat at dawn or dusk, and counting rabbits feeding at the brush edge. The error here lies in the fact that although this is one of the preferred feeding times, all animals may still not be exposed.

Compatibility with Humans. Unlike the deer or jackrabbit, brush rabbits can do quite well in smaller, isolated patches of natural brush. One of the highest brush rabbit densities I have ever studied was on Ano Nuevo Island, off the coast of Central California which is only 12 acres in size but, in 1968, contained at least 50 brush rabbits. This rabbit appears to hold up under potential dog and cat predation due to its dense brush retreat and secretive habits. It also seldom falls victim to autos because of its stay-at-home nature. This nature usually keeps it out of the backyard garden where a near relative, the cottontail, adapts well and can become a major pest. This species does not occur in the study area.

CALIFORNIA GROUND SQUIRREL (*Citellus beecheyi*)

Habitat Requirements. The California ground squirrel is one of the largest and most numerous rodents in the Hayward Hills area. It thrives in overgrazed pastures and on hillsides where former grassland has been disturbed by erosion or road building activities. Their whole ecology is closely tied to a burrow system which they dig and in which they raise their young, store food, sleep during the night, and seek protection any time that danger threatens. In order for such a "bomb shelter" escape system to be effective, these animals must be able to see for some distance around the burrow entrance. Foraging distance from the burrow appears to be gauged partly by this range of vision. They eat a variety of green vegetation and seeds which grow within the foraging limits of their burrow. They often store food when it is in abundance. During this study, members of one colony were observed for more than an hour carrying the seed heads of the bull thistle plant, which grew in abundance along one edge of a pasture area, back to the burrows.

Reproductive Biology. Females may have up to three litters of from four to fifteen young each throughout spring, summer, and fall. Young are weaned at about six weeks, up to which time their only predators in the burrow are gopher snakes, weasels, and perhaps an occasional badger. After weaning, they appear to undergo a period of dispersal to the edge of the colony and at this time are, no doubt, most vulnerable to a variety of mammalian and avian predation. Overall, however, predation seems to be rather moderate given the colonial lifestyle of this mammal, and very high populations may build up in a relatively short period of time.

Relative Abundance. The California ground squirrel has been enormously successful in expanding and maintaining its population in the Hayward area. Unlike most other mammals in this study, the diurnal nature of this species and its open habitat preference permits easy and fairly accurate counts. These ranged from one ground squirrel per twenty acres in ungrazed grassland belonging to the California State University, Hayward Research Foundation to densities as high as 15 squirrels per acre in overgrazed pastures bordering Fairview Avenue.

Compatibility with Humans. This species appears to be quite comfortable living in proximity with humans, as evidenced by how close it will dig its burrows to dwellings along Fairview Avenue. Ranchers in the study area consider this squirrel to be a pest which has invaded their pastures and, by competing with their cattle for the same food resource, has lowered the productivity of their ranches. However, the highest densities appear to be in areas which have already been overgrazed, a practice which, as mentioned earlier, produces optimal habitat for this species. Predation by most predators is, at best, only moderate due to their excellent defense mechanisms of this mammal, and its stay-at-home nature also makes for very few road kills. Perhaps the main, limiting factor to population size is lack of food, created by the population boom, itself. This species has been closely associated with plague since it, like many other mammals, carries the flea which transmits the disease. Colonial mammals, however, tend to have much heavier infestations, and thus large populations or, better yet, overgrazing practices should be discouraged.

FOX SQUIRREL (*Sciurus niger*)

Habitat Requirements. The fox squirrel is arboreal and inhabits evergreen woodland, particularly oak woodland. It feeds primarily on acorns and other seeds, terminal buds and leaves, fungi, and bird eggs. In Hayward and all along the West Coast, it is an introduced species which originated in the eastern United States. It has very few successful predators in the west, and thus its population densities are closely tied to the availability of food, particularly acorns.

Reproductive Biology. The fox squirrel mates in December and January, and again in May and June. The gestation period is 44 days. It nests either in tree cavities or builds a twig and leaf nest in the 'Y' of two branches. Females give birth to two to five young per litter, which are weaned at two to three months of age. The lofty nest position affords a high degree of protection for the young, although on one occasion during this study a large gopher snake was found in a leaf nest 70 feet above the ground.

Relative Abundance. The density of this species is directly proportional to the abundance of coast live oak and other large, seed-producing trees. We estimate it to be as high as one squirrel per acre in prime north-facing slope habitat in the study area.

Compatibility with Humans. The fox squirrel is not disturbed by human presence, as evidenced by its ability to live in good abundance in city parks. As long as the prime requirement of large, nut-bearing trees is present (especially if such trees are close enough together to make possible tree-to-tree transfer without going to the ground),

these animals may easily be encouraged in any area. They are particularly immune to dog predation, and only the most learned of cats can successfully harvest squirrels. Auto kills are surprisingly high for this species. Perhaps this is due to the fact that most trees do not bridge over roadways and thus the roads must be crossed on foot. Careful residential planning which leaves large oak trees and other species can produce a fox squirrel paradise. This, however, is always at the expense of local nesting song bird, due to the egg-eating habits of this mammal.

DUSKY-FOOTED WOODRAT (*Neotoma fuscipes*)

Habitat Requirements. The dusky-footed woodrat inhabits the broad sclerophyll forest and riparian woodland on north-facing slopes in the hills area. It is unique among local mammals, in that it builds a sizeable ground-level house of sticks. Houses measure up to one and a half meters in width and about a meter in height. They are cone-shaped, and are always built around an exposed tree root or low branch system for support. Within the house there is a nest chamber, a food storage area, and a dead-end tunnel, dug far under the support roots, which serves as a shelter in case a large predator breaks up the above-ground portion of the house. The animal carries sticks of a certain size and weight to build its house. Any other object which falls within the specified dimensions is also fair game for house material. If a woodrat is building near a barn or garage where there are light stick-like objects lying around, these will also be taken for the house. Hence, the term "pack rat" has been applied to a number of woodrat species throughout the west.

The dusky-footed woodrat is a rather strict browser, and terminal branch and leaf cuttings make up the majority of its diet. Woodrat food studies are rather easily conducted, since the animals climb into the low branches of trees at night, make terminal cuttings, carry them back to the house, and then leave many of them at the doorway of the entrance tunnel, to be dragged inside throughout the next day. Thus, an investigator need only visit a series of woodrat houses every morning for a week or so to compile a food list for the species in that area. Their diet in the Hayward Hills consists chiefly of coast live oak, poison oak, bay, and sage (if the house is near a coast scrub stand).

Reproductive Biology. The reproductive rate for the dusky-footed woodrat is surprisingly low for a rodent. Only one litter of three to four young are produced each year, usually in May and June. The young are born in the nest chamber of the female's house and stay in the shelter until they are weaned. Except for females with young, there is one woodrat per house, with sexes coming together only for breeding.

Relative Abundance. Because of the "one rat per house" rule, and since occupied houses can be easily recognized, direct counts are very easy for this species. All counts in this study were made on north-facing slopes, starting in riparian woodland at the canyon bottom and extending to the top of the hill. Densities ranged from 1.1 houses per acre on the California State University, Hayward Research Foundation property to 1.6 houses per acre at the south end of Garin Regional Park. This is down a bit from counts in previous years, under normal rainfall conditions. In 1969, for example, we recorded 1.8 houses per acre on the Research Foundation property.

Compatibility with Humans. This species must have moderate plots of riparian woodland and broad sclerophyll forest to survive. We estimate a minimum of 10 acres would support a small group of houses. They are not turned back by human presence and, as mentioned before, may even borrow a little house material from their primate neighbors. This species should not be confused with the rather undesirable Norway rat, which thrives in human dwellings. The dusky-footed woodrat is a far more beautiful rodent with a thick, soft pelage on both the body and the tail. Adult woodrats are rather large for domestic cats to handle, and dogs do not appear to attack and demolish woodrat houses the way coyotes do in wilder situations. The road kill on this rodent is also very low, due to its close confinement to the dense woodland. They are an important part of the woodland food chain, as are most other small mammals. Because of their easily recognizable house, this species' presence can easily be enjoyed by school classes and families, alike.

VALLEY POCKET GOPHER (*Thomomys bottae*)

Habitat Requirements. The valley pocket gopher inhabits fields where there is an abundance of green vegetation, and is also a well-known pest in lawns and gardens. It is primarily subterranean and constructs a series of tunnels in which it lives and feeds. Its presence is recognized by a mound of loose dirt, which is pushed out as the animal digs a tunnel. This sign is distinguished from that left by the western mole, which also leaves a ridge of broken ground above its very shallow tunnel. The gopher eats a variety of roots and tubers of grassland plants, and also may pull an entire plant into its burrow and eat it.

Reproductive Biology. In this area, the valley pocket gopher produces an average of two litters per year, with five to seven young in each. The young are born from October to June, which corresponds to the best months for grassland growth. Their life span is only about three years, but with a fair reproductive rate and excellent protection for the young, large populations can build up very rapidly. Young animals are ejected from burrow systems after weaning and undergo

a period of surface dispersal, during which time they are particularly vulnerable to a variety of predators. The adults, however, are only taken by surface predators when they extend about half of their body out of the hole, as they push dirt from the tunnel to the outside. Their reduced vision and the sudden change from darkness to bright light puts them at a great disadvantage at this time.

Relative Abundance. During normal rainfall years, we have documented densities ranging from 2.0 to 2.5 gophers per acre in various grassland situations in the Hayward Hills. However, during this study, we encountered many acre plots with no gopher signs whatsoever. Like so many other rodents surveyed, they appear to be at a record low in this drought year of 1977.

Compatibility with Humans. One need not comment to the avid gardner or lawnkeeper about gopher and human compatibility. They are simply a very successful, well-adapted rodent to any habitat situation which parallels their natural grassland habitat. Their real worth to humans lies in the key role which they play in the grassland food chain. With the exception of those years when cyclic species (such as the California meadow mouse) are at peak numbers, the valley pocket gopher is the number one grassland prey item, as revealed by the castings and scat of avian and mammalian predators. The take by domestic cats is also quite high, but dogs appear to have little success with this animal unless they are roaming away from their burrow. Road kill deaths by autos are almost unheard of.

CALIFORNIA MEADOW MOUSE (*Microtus californicus*)

Habitat Requirements. The California meadow mouse is a rodent of the ungrazed grassland. In the Hayward area, it eats grasses such as wild oat, rye, and brome (Schwan, 1972). In winter, it eats the stems and leaves of these grasses, but as the grasses dry up in late spring, it feeds more on their seeds throughout the summer and early fall months (Batzil and Pitelka, 1971). Besides providing food, lush and ungrazed grass also permits the construction of surface tunnels through the matted, old grass at the ground surface. These tunnels serve as avenues for travel to food, through which the mice can move with minimum exposure to predators. In one portion of a tunnel system, commonly referred to as runways, a small depression is scraped out in the soil, and here the breeding nest is constructed of finely shredded grass. Because of this great dependence on dense grass, this species cannot exist in heavily grazed fields.

Reproductive Biology. The California meadow mouse is capable of very high reproductive increase under good habitat conditions. Females become sexually mature at three weeks of age. The gestation

period is only 21 days, and the young are weaned at two weeks. The average litter size 4.2, with a range of 1 to 9 per breeding. Breeding takes place throughout the year but is at its low ebb in summer.

Relative Abundance, This species is cyclic, and exhibits large fluctuations in the number of individuals, with peaks and lows occurring at three- to four-year intervals under stable climatic conditions. Numerous theories have been put forth as to the reason for this cyclic activity. Batzli and Pitilka, 1971, and Lidicker and Anderson, 1962, point out the relationship between breeding activity and food supply, which in turn is dependent on the rainfall and temperature in any particular year. Pearson, 1964 and 1971, submits excellent field data gathered in the East Bay hills to support his theory that carnivore predation during the peak population periods determines, to a large extent, the amplitude and timing of the cycle.

The 3-4 year microtine cycle, as it is termed, is a localized event, and one area of the East Bay hills may be experiencing a peak while another is at low ebb. The last peak year in the grassland owned by the California State University, Hayward Research Foundation occurred in the spring and summer of 1974. At that time, meadow mice were seen running across roads and exposing themselves outside the tunnel systems throughout the day and night. In August of that year, the predicted die-off or crash occurred, and in September a grassland fire swept through the area. The fire removed all vegetation and exposed 96.7 meadow mouse skulls per acre (Hammerson and Heath, in press). This high density is still, no doubt, a low estimate of the high or peak population, since many mice were taken by predators before the crash was complete. Lidicker and Anderson recorded 350-400 mice per acre during one peak year, under most favorable habitat conditions.

The year 1977 should have been the present cycle, during which the population was building towards a peak in the summer of 1978. However, the drought of the past two years appears to have disrupted the cycle greatly. We were unable to capture a California meadow mouse in the old study area during three nights of trapping. This does not necessarily mean they are all gone, since human trap lines are never able to "get the last mouse", so to speak. However, they are most certainly at an all-time low this area. Yet, given a return of normal rainfall, this species will be back at its high peak number in four years or so.

Compatibility with Humans. This species can, and often does, live in ungrazed fields adjacent to human habitation. Unlike the house mouse or deer mouse, it rarely invades homes, since its food requirements can only be properly met in the grassland situation. In reference to its overall worth, it is a key prey item in the grassland food chain. Its presence in moderate to high numbers greatly

determines the numbers of hawks, owls, foxes, and other interesting predators which may be daily observed in the area. The reasons for a preference for this prey item are several. First of all, it is the largest of the mice (over twice the size of the average house mouse) and, thus, a predator gets twice the meat for the same effort when it catches a meadow mouse. It is the only mouse that is equally active during the day as at night, and this permits utilization by diurnal as well as nocturnal predators. Finally, the grass tunnel system is apparently not a foolproof form of protection, and even human observers can spot these creatures traveling past thin portions of the tunnel or runway roofs. Domestic cats are very efficient at catching this mouse, and during peak years, the presence of this prey item in nearby fields can greatly reduce the ever-rising cat food bill. Dogs appear more intent on digging out runways than catching the mouse, and road kills are few.

HOUSE MOUSE (*Mus musculus*)

Habitat Requirements. The house mouse is found almost everywhere and is often a pest in barns, garages, and houses. It is not a native of this area, but instead came to the New World in the first sailing ships arriving at our shores, and since then has spread throughout the continent. It is a prime example of an introduced species rapidly occupying an ecological niche to which no native species is really well adapted. That niche, of course, is the human dwelling, and this adaption was acquired through centuries of natural selection in Europe, prior to the discovery of America. It is also capable of living successfully in wild habitats, especially grassland. Since it is, in a way, a domestic species, we refer to populations living in natural areas as "feral" house mice.

The feral house mouse has about the same food preferences in the grassland as the California meadow mouse and, therefore, to a fair extent competes with this species (Walker, 1964; Ingles, 1965). It digs underground burrows (Newsome, 1969) but will also use meadow mouse runways (Pearson, 1963). It tends to cycle along with, and in response to, the meadow mouse.

Reproductive Biology. In Coastal California, the house mouse breeds from early spring to mid-fall, with population densities declining as winter progresses (DeLong, 1967). Females are capable of mating at 35 days of age (Walker, 1964), and produce three or four litters per season (Pearson, 1963; Lidicker, 1966). The litter size ranges from three to twelve (Walker, 1964).

Relative Abundance. From 125 traps set in 10 acres of grassland on regional park land during this study, only one house mouse was caught. In 1973, 50 traps were set in the same area and an average

of 1.5 house mice per acre were taken. In 1974, when the census of rodent skeletons occurring in eight acres of burned grassland was taken, three house mouse skeletons were recovered (Hammerson and Heath, in press).

Compatibility with Humans. As already mentioned, the house mouse is very compatible with humans, to the point of being a constant pest. It is human presence that promotes this species, and there is much evidence to indicate that during periods of habitat stress, as in these drought years, this species relies heavily on human dwellings and food supply (a trait not normally found in our native rodent species).

WESTERN HARVEST MOUSE (*Reithrodontomys megalotis*)

Habitat Requirements. The western harvest mouse is the smallest rodent in the hill area. It inhabits ungrazed grassland, along with the former two species. It is a native, and has evolved to avoid competition with the larger meadow mouse by feeding primarily on the seeds of grasses. Its small size allows it to partially climb the grass stalks and to bend down the seed heads to a point where it can feed on them. It builds a nest above ground out of dead grass and also uses the runways of the California meadow mouse. In times of seed scarcity, it will also eat green portions of plants and, occasionally, insects.

Reproductive Biology. This species begins breeding in March, and continues through late fall. The last litters of the season occur in September during years of limited food supply, and as late as January during years of abundant food (Pearson, 1960). Females produce an average of four litters per year, which range from one to seven young each (Cowan and Guiget, 1965; Fisler, 1965). Gestation period is about 24 days, and the young are weaned at three weeks (Sulhla, 1931). Females are capable of breeding shortly thereafter and, thus, this species also has the ability to increase its numbers greatly in a relatively short period of time, under good habitat conditions.

Relative Abundance. Populations as high as 50 harvest mice per acre have been reported in other East Bay areas (Pearson, 1963). In a survey of burned grassland in the study area in 1974, one harvest mouse skeleton per acre was discovered. During previous normal rainfall years, trapping success for the western harvest mouse in Hayward Hills grassland has been moderate to good, averaging about 0.5 mice per acre. This year, we were unable to capture a single harvest mouse in the same grassland areas. This species is probably affected even more by the drought than the other grassland species, since seed production appears to be far more curtailed than leaf growth.

Compatibility with Humans. Like the California meadow mouse, the western harvest mouse requires tracts of ungrazed grassland to survive. When present, they are an important prey item in the grassland food chain, especially for the smaller owls and hawks. They normally do not invade homes, but may be found around hay barns.

HEERMAN KANGAROO RAT (*Dipodomys heermanni*)

Habitat Requirements. The Heerman kangaroo rat occupies areas of coastal scrub, where it digs extensive burrows between the root systems of the plants. It is a seed gatherer, and uses its external cheek pouches to carry seeds from the gathering site to a food storage area in the burrow system. It will also eat new growth vegetation when available in the scrub community. Its main form of protection is its speed over the bare, open soil of the coastal scrub area to the burrow retreat.

Reproductive Biology. This species breeds from February to October, and females have from one to three litters per year, with two to five young in each litter. Females usually breed during their first year of life. This species is very long-lived compared to other mouse-type rodents. Captive individuals have been known to live up to ten years.

Relative Abundance. No kangaroo rats were caught during the course of this study. However, in 1973, four nights of trapping in approximately 20 acres of hill area grassland produced one individual. The normal density for this species, in good habitat, ranges from one to seven per acre (Burt and Grossenheider, 1976). The very low Hayward Hills population is, no doubt, due to the lack of high annual seed production among the plants of the local coastal scrub community.

Compatibility with Humans. Once again, large tracts of undisturbed coastal scrub and fringe are necessary for this species. Its numbers may be increased in areas where introduced seed-producing plants, particularly legumes, are present. To our knowledge, the kangaroo rat never invades human dwellings.

CALIFORNIA POCKET MOUSE (*Perognathus californicus*)

Habitat Requirements. California pocket mice inhabit east- and south-facing slopes with coast live oak and coastal scrub in fair abundance. They may be best described as a miniature version of the kangaroo rat and, again, gather seeds and carry them in their external cheek pouches to a storage area. They are about one-third the size of kangaroo rats, and appear to avoid direct competition with this species by taking the smallest size seeds available.

Reproductive Biology. One litter per year is produced, containing from two to six young. This is an extremely low reproductive rate for such a small mouse, but, again, this species has an unusually long life span, with individuals surviving more than ten years in captivity.

Relative Abundance. No California pocket mice were captured during this study. Again, we attribute this to the severe curtailment of seed development in this drought year. However, several pocket mice have been trapped in oak woodland areas near the Ecological Field Station of California State University, Hayward over the past several years.

Compatibility with Humans. Permanent stands of oak woodland and coastal scrub are vital to this species' existence. Like the kangaroo rat, it does not invade human dwellings. Both species make excellent classroom study animals. They live very well in cages provided with deep soil for burrowing. Unlike other mice, they are just about odorless, since they excrete a very dry fecal pellet. They live entirely on seeds and do not need drinking water. In larger cages, they will go through their normal seed gathering and cheek-pouch storing behavior, to the delight of both young and old students.

DEER MOUSE (*Peromyscus maniculatus*)

Habitat Requirements. The deer mouse is primarily a mouse of the riparian and broad sclerophyll woodland, and is strictly nocturnal (Orr, 1959; Ingles, 1965; Marten, 1973). Its diet consists of buds and cambian insects, seeds, and berries (Kritzman, 1974). It digs shallow burrows when necessary, but prefers retreats under fallen logs or in unused portions of woodrat houses.

Reproductive Biology. Breeding season is from March to August. They have up to four litters per year (McCabe and Blanchard, 1950), and have three to six young per litter (Bert and Grossenheider, 1976). Like most mice, they only live a few years.

Relative Abundance. Although the deer mouse is the most abundant mouse in woodland areas in the Hayward Hills, its numbers are consistently far less than those of the true grassland species. They are normally harder to trap, since they do not create good "sign" to guide the trapper, and in the absence of runways or extensive burrow systems, the traps must be set at random. We averaged only one deer mouse per ten acres during the study period, but the same north-facing slopes have yielded up to one mouse per acre in normal rainfall years. Deer mice do not undergo dramatic population cycles like the grassland mice previously discussed.

Compatibility with Humans. Preservation of strips of riparian woodland is particularly vital in maintaining natural deer mice populations. They are a key item in the woodland food chain and their relative abundance determines greatly that of many larger prey species. This is the mouse which is most often seen scampering through the backwoods cabin, and it will invade such structures if it is located directly adjacent to prime habitat.

PINYON MOUSE (*Peromyscus truei*)

Habitat Requirements. The pinyon mouse is a slightly larger version of the deer mouse, and inhabits dense oak woodland and upper reaches of north-facing slopes. It feeds primarily on acorns from the coast live oak, along with seeds and fruits of other woodland species such as toyon, snowberry, blackberry, and hazelnut. It does some burrowing and also seeks out retreats under logs and root systems.

Reproductive Biology. The pinyon mouse breeds throughout spring and summer, and may have up to four litters during this period. There are from three to six young per litter (Burt and Grossenheider, 1976). This is also a non-cyclic species.

Relative Abundance. We have obtained densities of from 0.5 to 1.0 pinyon mice per acre in past years near the Ecological Field Station of California State University, Hayward. This year, no pinyon mice were trapped. This species seems to have been especially hard hit by the drought, as the acorn crop was practically absent this year.

Compatibility with Humans. Oak woodland stands and good riparian woodland edge situations are vital for this species. They are also a very important part of the woodland food chain, since their habitat preference of oak woodland makes them more available to avian predators.

CALIFORNIA MOUSE (*Peromyscus californicus*)

Habitat Requirements. The California mouse is the largest of the deer mouse types and inhabits coastal scrub areas. Here, it feeds on seeds and fruits and also takes many insects in spring and summer. Thus, each major wooded area in the Hayward Hills contains a mouse species particularly adapted to that specific vegetative type.

Reproductive Biology. This mouse breeds throughout the year with the lowest ebb in winter. Females have up to four litters per year (Drickman and Vestal, 1973), with three young being the maximum litter size. This larger mouse shows a slower reproductive turnover (as might be expected), and females do not breed until about four and one-half months, an age at which a California meadow mouse female is usually a great-grandmother.

Relative Abundance. Trapping during the study period produced only one California mouse per 20 acres. Once again, this was far below former counts. In 1969, averages of about one mouse per acre were common.

Compatibility with Humans. As with the other species, habitat preservation is of utmost importance. In the case of all three *Peromyscus* species, cat and dog predation appears to be rather low and is apparently buffered greatly by the far more abundant grass-land forms.

Before ending this section on mice, perhaps a word or two is appropriate concerning the extremely low numbers during this drought year. One logical question here is simply, "Are some species gone forever?" Even though moderate trapping pressure did not produce a species of mouse in an area where prior trapping produced many, it is unlikely that every individual has died. Trapping usually skims off the less wary or, as we say, the more trap-prone animals. Also, during severe climatic periods, many species will greatly reduce their activities and, instead, den up where they rely on stored food. Therefore, although many mouse populations are exceedingly low, we look for a rapid and rather dramatic comeback with the return of the rains.

SHREWS AND MOLES (Order *Insectivora*)

These are truly the mystery quadrupeds of the Hayward Hills. They inhabit moist soil areas in the riparian woodland where the shrews forage in the leaf litter for insects and the mole burrows just below the surface of the ground in search of soil invertebrates. Only by chance is one of these insectivores occasionally caught in standard mouse traps, and none were obtained during the study period. Surface tunnels of the coast mole (*Scapanus oratus*) were observed along Zeile Creek in June, 1977, and one ornate shrew (*Sorex ornatus*) was trapped near the Ecological Field Station in 1973. The trowbridge shrew (*Sorex trowbridgii*) is also known to occur in the area. Shrews and moles appear to have relatively few predators, partly because of their secretive habits and also because of their reputed bad taste. Often a domestic cat will catch a mole but then refuse to eat it. Both groups need the riparian woodland for survival, and the coast mole can be a pest in lawn situations.

BATS (Order *Chiroptera*)

Even more elusive than the insectivora are the bats of the Hayward Hills area. Any halfway complete study of the group would demand as much time as has been accorded all other vertebrates in this study. They are nocturnal feeders and, no doubt, play a large roll

in keeping populations of flying insects in check. They require rock outcroppings and cracks in large trees for daytime and winter retreats. They will also use old barns and sheds but, with the disappearance of the latter, the natural areas become more important. They have a low reproductive rate but experience virtually no natural predation. They have the potential of carrying rabies, but the extent to which this actually occurs in the local populations is unknown. The species which are reported to occur in the study area are as follows: California myotis (*Myotis californicus*), long-eared myotis (*Myotis evotis*), western pipistrelle (*Pipistrellus hesperus*), big brown bat (*Eptesicus fuscus*), hoary bat (*Lasiurus cinereus*), red bat (*Lasiurus borealis*), silvery-haired bat (*Lasionycteris noctivagans*), pallid bat (*Antrozous pallidus*), lump-nosed bat (*Plecotus townsendii*), Brazilian free-tailed bat (*Tadarida brasiliensis*).

THE CARNIVORS

We conclude the mammal portion of the report with a section which describes a group of medium- to large-size mammals that can be collectively called carnivores. For the most part, these species represent the last link in the food chain, and thus their numbers are directly influenced by those of the prey animals on which they feed. Although these mammals are larger than the prey species on which they feed, direct observation and trapping success is greatly limited here. They are, for the most part, far more intelligent than their prey and are keenly aware of human presence and how to avoid it. It is, therefore, indirect evidence such as footprints and scat, or the occasional chance observation, which provides some knowledge of their presence. Since chance observation over extended time periods is such a valuable tool here, a survey of 100 residences in the Hayward Hills was conducted. A detailed analysis of this survey will be presented later in this report, but reference will be made to it throughout the following accounts.

OPOSSUM (*Didelphis marsupialis*)

Habitat Requirements. The opossum is the only marsupial mammal in North America. It is not native to the western states but, since its introduction into California, it has spread to all areas of the state except the High Sierras and the deserts. It is technically an omnivor, capable of feeding on a variety of animals, as well as plant foods. In the hills area, they inhabit mainly riparian and broad sclerophyll woodland, and feed on insects, mice, eggs, nuts, and buds. They also have a taste for vegetables and garbage and, therefore, this is one of the most frequently observed of the larger mammals, as reported in the wildlife survey. They have a home range which may vary from 15 to 40 acres (Burt and Grossenheider, 1976).

Reproductive Biology. Females have one or two litters per year, with up to 14 young per litter. The young are born after a gestation period of only 13 days. They crawl directly into the pouch, where they remain and nurse for the next two months. Opossums live to about seven years of age.

Relative Abundance. The opossum seems to be in good numbers wherever it is found. In the Hayward Hills, it is, no doubt, one of the most numerous carnivorous mammals. The large population size may be attributed to several factors. First, it has a high reproductive rate for an animal of its size, and it affords the young a high degree of parental care. It also possesses two basic forms of defense; shame rage and "playing 'possum" (dead). These defense forms apparently are effective on a wide variety of wood-be predators.

Compatibility with Humans. As already mentioned, the opossum is highly attracted to gardens and garbage cans. In fact, the spread of the species throughout most of the United States during the past century is mainly attributed to the feeding opportunities afforded by agriculture and human habitation. Their defense patterns work well with cats and dogs, but the automobile appears to take a rather large toll, and it is not uncommon to find a road-killed mother and young on a residential road in the hill area.

RACCOON (*Procyon lotor*)

Habitat Requirements. The raccoon is frequently found around water where there are wooded areas nearby, although they do wander some distance from water when foraging. Like the opossum, it is omnivorous and feeds on crayfish, fish, frogs, birds, bird eggs, turtles, rodents, insects, fruits, berries, and nuts. It occupies dens in hollow trees, hollow ground logs, or ground burrows during the cooler periods of the year.

Reproductive Biology. Females give birth to from two to seven young between December and April, after a gestation period of 63 days. There is only one litter per year.

Relative Abundance. Sightings of raccoons by Hayward Hills residents are also quite frequent. Unlike the opossum, which simply appears to wander through residential areas without being very aware of its surroundings, the raccoon exhibits far more intelligence in its contact with humans, and it is probably overlooked more often than it is seen. Raccoon tracks were seen at all water sites visited during the study. These tracks, along with those of the opossum, appear as miniature handprints. However, raccoon prints always exhibit noticeable claw marks, while opossums do not. An estimate for raccoon density in good habitat is one per twenty acres, and this is probably realized in the prime sites for raccoon in the hill area.

Compatibility with Humans. As long as there is good riparian cover near human habitation, the raccoon seems to do quite well. There are numerous sites in the Oakland and Berkeley Hills, for instance, where the raccoon is a common backyard animal. This is because there are tree and brush areas between most of the houses, and ponds or creeks are available somewhere in the area. Single dogs seldom bother an adult raccoon, and road kills are far fewer than those of opossum. They are perhaps the most compatible predator in the Hayward Hills, and public response to this species appears most favorable.

STRIPED SKUNK (*Mephitis mephitis*)

Habitat Requirements. The striped skunk is omnivorous and feeds primarily on mice, bird eggs, insects, berries, and carion. Droppings of striped skunk, located during this study, contained only exoskeletons of insects. This suggests that perhaps skunks are relying heavily on this food source during this year, when mice numbers are very low and fruit production is curtailed.

Reproductive Biology. Females have one litter, usually early in May, averaging five to six young. The young are weaned in late June or July, and may accompany the female even after this period.

Relative Abundance. The striped skunk is perhaps the most often-seen predator in the hill area. The major reason for this is that it makes no effort not to be seen. Its unique defense is coupled with an advertising-type color pattern which allows would-be predators to recognize the skunk before it is "too late". We see them with good regularity in the area surrounding the Ecological Field Station, and an estimate of the population in this area is one per 25 acres.

Compatibility with Humans. Skunks seem to accept human presence and dwellings far more rapidly than man accepts them. They have been known to den up underneath a house, where they may live for some time before being noticed. They can be garden pests, and thrive in agricultural areas. Their defense appears near perfect against cats and dogs. The road kill of this species is high, and may be due to what seems to be rather poor eyesight and definitely slow movement.

GREY FOX (*Urocyon cinereoargenteus*)

Habitat Requirements. The grey fox is most at home in the brushy cover of the riparian woodland and coastal scrub, but will hunt the grassland and upper wooded slopes, as well. It is primarily

carnivorous and feeds on gophers, woodrats, rabbits, pocket mice, and birds. It also eats berries of toyon, blackberry, and other shrubs when in season, along with larger insects.

Reproductive Biology. The grey fox mates once a year, in late February, and gives birth to from three to seven pups in April or May. Dens are usually underground. One was located in the study area in 1974, in a deep rock crevice, and contained four pups.

Relative Abundance. Unlike the previous predator mentioned, the grey fox is extremely shy and wary of human presence. There also is some evidence to indicate that it vacates an area when human presence becomes prominent. It is also one of the least-frequently reported animals in the hill area survey, but again this could be due, in part, to its extreme wariness. It is certainly present in moderate numbers, but an exact count cannot be given.

Compatibility with Humans. Unlike the preceding predatory mammals, the grey fox appears to move out as human presence increases. Whether its home range must be void of human contact, or whether the competition with domestic predators such as the house cat is too great is hard to say, but most field biologists agree it does not adapt as well as opossums, raccoons, and skunks. It is perhaps one of the best indicators that human population has gone beyond some yet-to-be-defined threshold of animal tolerance.

BOBCAT (*Lynx rufus*)

Habitat Requirements. The bobcat is capable of living in every habitat type found in the hills area, but the few that remain probably prefer the coastal scrub and woodland areas. It is a small mammal hunter and does well wherever rodent populations are high.

Reproductive Biology. One litter, averaging three kittens, is born during the spring or early summer months. The preferred den site is usually a sheltered place in a rocky area.

Relative Abundance. We did not see any bobcats during the three months of the study. However, several respondents to our wildlife questionnaire claim to have seen or heard them. This seems reasonable, since they do still occur throughout the Coast Range, but are extremely secretive. They also are, no doubt, meeting stiff competition from both domestic and feral house cats. It is not that house cats are any better hunters than bobcats, but the domestic form is not deterred from hunting within sight of human dwellings; but the bobcat apparently is. As human dwellings increase, this desire to go unseen and undisturbed must lead to the evacuation of that area, all to the further benefit of the domestic cat.

Compatibility with Humans. As just mentioned, they do not seem compatible in any sense of the word. It is, again, a true wilderness indicator and leaves as humans arrive.

HOUSE CAT (*Felis domesticus*)

Habitat Requirements. The domestic cat has, to a large extent, replaced the grey fox and bobcat in many areas as the primary small mammal predator and, therefore, is worthy of mention here. The domestic house cat often either wanders away from home during the day or night to forage in wild area, or becomes feral and takes up permanent residence in the natural habitat. The domestic cat primarily feeds on rodents (rat-size and smaller). During the course of this study, we recovered the skulls of house mice, pinyon mice, western harvest mice, and the California meadow mouse from the scat of feral and domestic cats. As earlier reported, we were unable to trap the majority of these rodents during numerous tries. An unusual amount of insect remains were also found, indicating that even this efficient predator is still a bit hard-pressed for protein.

Reproductive Biology. House cats begin breeding at seven to twelve months. Females have two heat periods a year: in spring and fall. The average litter size is four kittens for feral cats, and the gestation period is 63 days (Asdel, 1964).

Compatibility with Humans. There is no need to comment on domestic cats, of course, but when domestic cats become feral, they seem to take on a wary attitude towards humans. However, feral cats can be easily observed from a distance and, therefore, continue to hunt in and around homes when the fox and bobcat do not.

Relative Abundance. Counting domestic and feral cats is much easier than counting truly wild forms because of their exposure, and the fact that the great variation in color patterns resulting from centuries of selective breeding makes possible individual recognition. In past years, we have obtained counts as high as one cat per five acres in the grassland north of the Ecological Field Station. During this study, we estimate no more than one cat per 50 acres. Based on sightings over the past decade, and comparative numbers of droppings recovered in the field, we feel that the house cat, both domestic and feral, is the number one small mammal predator in the hills area.

MOUNTAIN LION (*Felis concolor*)

Habitat Requirements. Mountain lions feed primarily on deer. In fact, they are one of the most prey-specific predators known, and where deer populations are good to high, the mountain lion is

usually there. Unlike other predators discussed so far, no one mountain lion probably lives permanently within the study area. A recent study by the California Department of Fish and Game reports home ranges of up to 60 square miles for males. The hills area is no doubt included in the home range of one or more of these big cats, and the time spent in this area during the course of a year is probably determined by hunting success and the amount of human disturbance it encounters.

Reproductive Biology. Mountain lions give birth once a year, usually in the spring, to up to four kittens (although the normal litter is two or three). Dens are almost always in large, rocky outcrop areas, in a cave or crevice.

Relative Abundance. All we can say for sure is that mountain lions are seen at irregular intervals in the Hayward Hills. Six out of 42 respondents in the questionnaire survey report sightings, most of them several years ago. Unlike bobcats or coyotes, there is really no other animal to confuse a mountain lion with, and even if we take half as being valid, it still confirms their presence in recent years. In addition, a reliable observer, who had previously sighted mountain lions in the Rocky Mountains, saw one crossing the dirt road to the Ecological Field Station of California State University, Hayward in 1972. Two weeks later, one of three yearling deer which were then in captivity within the two-acre fenced area around the station was found one morning with deep scratches on its neck and one ear nearly chewed off. The fence is six feet high chain link with an additional foot of angled barbed wire. It is also tight to the ground, and no tunneling was observed. We concluded that this was a mountain lion attack which was perhaps terminated by the cries of the deer which, in turn, caused our captive California sea lion to bark, thus frightening the cat off. Keep in mind this was an attempt to eat a natural prey item. There were no reports of mountain lions killing stock.

Compatibility with Humans. The mountain lion appears to avoid human contact at all costs, and only by random accident is it ever observed. It appears to have an even greater aversion to dogs, which also acts to keep it away from populated areas. Ironically, it is in such areas that totally protected deer herds are many times overbrowsing the range and a natural predator is badly needed. Throughout the history of the west, there are only a few authentic cases of mountain lions attacking humans. Today, the probability of dog attacks are many hundreds of times greater.

COYOTE (*Canis latrans*)

Habitat Requirements. The coyote is now found throughout the "lower 48" and has invaded nearly all available habitat. This dramatic

spread has taken place primarily as a result of the extermination of its larger relative, the wolf. It feeds on a variety of medium- and large-size rodents. Scat recovered in the study area contained an abundance of woodrat and gopher skulls. A coyote is capable of taking young deer, but rarely attacks adults. We received no reports of coyote attacks on livestock.

Reproductive Biology. Coyotes give birth in early spring to an average of six or seven pups, although up to 11 have been reported (Ingles, 1965). The birth site is usually an underground den which is dug by the bitch. Pups receive a high degree of parental care, and with this rather large potential natality for a large predator, local populations can increase rapidly.

Relative Abundance. Coyotes have been only heard, not seen, in the hills study area. Although the survey of hills residents report no sightings, we feel that this is not indicative of their abundance since they are easily confused with dogs. Several individuals are probably resident in the Hayward Hills area.

Compatibility with Humans. Like the other large predators mentioned, the coyote avoids human presence. The attacks by coyotes on stock throughout the country have been highly exaggerated, and many of those which have been thoroughly investigated in California have turned out to be attributed to dogs. However, given adequate tracts and corridors of wildlands around and through residential areas, it can persist and pursue its role as a needed rodent predator.

DOMESTIC DOG (*Canis familiaris*)

Because the dog does not occur in a truly wild state (as yet) in the hills area, we shall forgo the categories used for the other mammals in this report and instead simply comment on this problem mammal. To many people, the family dog or dogs rank favorable with Mother, God, and Country in the hearts and minds of their owners. This is easy to understand, since a good dog is an excellent companion, provides a certain degree of security to a household, and easily blends in as the added member of the family. From a wildlife standpoint, however, the dog must be kept in its proper place. This place should be within the confines of the owner's house or yard, on a leash, or, at the very least, under strict sight and voice control of the owner. We are just beginning to realize the destructive potential of dogs, both on wildlife and humans. Respondants in the wildlife survey report that dogs or dog packs were the only species observed to kill livestock and run deer. One family with a small farm on Hayward Boulevard had 30 sheep killed in two days by dog packs. Reports of single domestic stock kills were frequent. The emphasis in recent years on large guard dog breeds with selection for aggressiveness has, no doubt, magnified this problem and increased

the number of human attacks and child deaths. We must remember that when individuals of a breed are purposely selected for such aggressive traits, the domestication process is now working in reverse, and we are now producing a more wolf-like animal, but without the inherent shyness of the wild canine. Next to the destruction of natural habitat, dogs are, in our opinion, the most destructive form of wildlife. Just the scent of dogs, which remains for some time after a romp through the countryside, can deter a number of wild species from using the area for some time. The dog problem must be dealt with soon.



PLATE II

RUFIOUS-SIDED TOWHEE
(*Pipilo erythrophthalmus*)

CHAPTER III—THE BIRDS (Class *Aves*)

AN INTRODUCTORY NOTE

With the exception of a few of the larger, wild mammals, the birds are the only vertebrates with great mobility, and although many require specific hill area habitats for breeding and feeding, many more simply pass through on their way to breeding grounds in the north. Still others use the hill area as a wintering range, and are absent in the spring and summer months. Also, the birds are far more numerous than any other species complex. This report, therefore, deviates from the standard species account in this class and instead presents an abbreviated account for each bird, followed by a summary checklist and summary remarks.

SPECIES FOUND IN THE HAYWARD HILLS

Pied-billed Grebe (*Podilymbus podiceps*) Rare visitor to ponds and reservoirs; feeds on small fish which it captures by subsurface pursuit.

Great Blue Heron (*Ardea herodias*) Visitor to ponds and reservoirs; feeds on fish, frogs, and other small aquatic organisms occurring in shallow water; will also hunt meadow mice in grasslands during periods of abundance.

Green Heron (*Butorides viresens*) Very rare visitor to ponds, reservoirs, and streams; feeds on fish, frogs, and other small aquatic organisms in shallow water.

Snowy Egret (*Egretta thula*) Rare visitor to ponds and reservoirs; feeds on fish, frogs, and other small aquatic organisms in shallow water.

Great Egret (*Casmerodius albus*) Rare visitor to ponds and reservoirs; feeds on fish, frogs, and other small aquatic organisms occurring in shallow water.

Mallard Duck (*Anas platyrhincos*) Visitor and possible breeder in ponds and reservoirs; feeds on small aquatic plants and animals by "dabbling" or filtering with the bill up to 1/4 meter below surface; a "puddle duck" which can take off from small ponds.

Gadwall Duck (*Anas strepera*) Rare fall-through-spring visitor to ponds and reservoirs; feeding similar to that in mallard; a "puddle duck" type.

Pintail Duck (*Anas acuta*) Uncommon to rare visitor, fall through spring; feeding similar to that in mallard; a "puddle duck" type.

Green-winged Teal (*Anas crecca*) Rare fall-through-spring visitor to ponds and reservoirs; feeding similar to that in mallards; a "puddle duck" type.

Cinnamon Teal (*Anas cyanoptera*) Rare fall-through-spring visitor to ponds and reservoirs; feeding similar to mallard; a "puddle duck" type.

American Wigeon (*Anas americana*) Rare fall-through-spring visitor to ponds and reservoirs; feeding similar to that in mallard; a "puddle duck" type.

Northern Shoveler Duck (*Anas clypeata*) Rare fall-to-spring visitor to ponds and reservoirs; feeding similar to that of the mallard; a "puddle duck" type.

Wood Duck (*Aix sponsa*) Rare fall-through-spring visitor to ponds and reservoirs; feeding similar to that in the mallard; a "puddle duck" type.

Ring-necked Duck (*Aythya collaris*) Rare fall-through spring visitor to large ponds and reservoirs; feeds on small aquatic plants and animals obtained by diving beneath the surface. This and other diving ducks thus exploit a feeding area unavailable to the dabbling ducks. However, they cannot take off vertically, due to the rearward positioning of the legs for diving, and therefore are normally unable to feed in small pond areas which do not have the necessary "takeoff runway" surface area.

Canvas Back Duck (*Aythya valisneria*) Rare fall-through-spring visitor to large ponds and reservoirs; feeding is similar to the ring-necked duck; a diving duck.

Lesser Scaup Duck (*Aythya affinis*) Rare fall-through-spring visitor to large ponds and reservoirs; similar to the ring-necked duck in feeding; a diving duck.

Ruddy Duck (*Oxyura jamaicensis*) Rare fall-through-spring visitor to large ponds and reservoirs; feeding similar to that of the ring-necked duck; a diving duck.

Hooded Merganser (*Lophodytes cucullatus*) Rare through fall, winter, and early spring in large ponds and reservoirs; feeds by diving and capturing fish by pursuit; a diving duck.

Turkey Vulture (*Cathartes aura*) A common breeding resident; found in all Hayward Hill area habitats, but breeds only where large cavities in rocks or logs provide protection for the nest; groves of tall eucalyptus provide important roosts; feeds on carrion and has, no doubt, increased in many areas of human population as a result of auto road kills of other animals.

White-tailed Kite (*Elanus leucurus*) Irregular visitor to grassland, oak savanna, and pasture land where scattered large trees provide nesting and roosting sites; feeds primarily on the California meadow mouse, and its numbers vary with the cyclic abundance of this rodent; during lows in the mouse cycle, it appears to move to other areas which are experiencing a mouse high; feeds from a hovering position, usually in grassland areas.

Sharp-shinned Hawk (*Accipiter striatus*) Uncommon-to-rare winter visitor in and around broadleaf sclerophyll forrest; feeds mainly on small birds.

Cooper's Hawk (*Accipiter cooperi*) Uncommon-to-rare winter visitor and possible rare breeder in and around broadleaf sclerophyll forrest; feeds mainly on small birds.

Red-tailed Hawk (*Butes jamaicensis*) A common resident, found in or about all habitats, but nests in tall trees (usually eucalyptus); forages by soaring over open country, spotting ground prey, and diving for the capture; feeds on small mammals, especially the California ground squirrel, snakes, and lizards. This is one of the most visible birds in the hill area due to its soaring flight, and certainly one of the most important checks on diurnal rodent populations.

Golden Eagle (*Aquila chrysaetos*) Rare visitor but regularly observed passing over many hill area habitats; does not breed here, but forages over grassy hills for rabbits and ground squirrels.

American Kestrel (*Falco sparverius*) Breeding resident of grassland, open woodland, and pasture land; breeding is dependent upon availability of holes in trees which provide nest sites; feeds primarily on large insects and occasionally on small mice.

California Quail (*Lophortyx californicus*) Common breeding resident of coastal scrub and riparian woodland, plus brushy borders of farms; seeds, insects, and new leaves and buds of ground plants make up the majority of its diet; it is the only native game bird

besides the morning dove which breeds in the study area; it was the most abundant larger bird reported in the survey of Hayward Hills residents.

Ring-necked Pheasant (*Phasianus colchicus*) Common, introduced breeding resident in grassland and coast scrub areas and near brushy borders of farms; feeds on seeds, insects, fruits, and new leaves in the grass and brushland; the largest game bird in the hill area.

American Coot (*Fulica americana*) Rare visitor to ponds and reservoirs; feeds on aquatic plants and animals, plus seeds and insects obtained on the ground.

Killdeer (*Charadris vociferus*) Common visitor to lawns and fields in residential and agricultural areas, and a rare breeder along margins of ponds and reservoirs; feeds on small invertebrates found along mud shore, on moist soil surface.

California Gull (*Larus californicus*) Uncommon late-summer-through-spring visitor to fields and lawns of residential areas and farms; also can be found around larger ponds and reservoirs; feeds on just about any edible object that can be captured and swallowed.

Ring-billed Gull (*Larus delawarensis*) Uncommon late-summer-through-spring visitor to lawns, houses, farms, and fields in the study area; feeding similar to that of California gull.

Forster's Tern (*Sterna forsteri*) Rare visitor to ponds and reservoirs where it feeds on small fish, usually by diving from a hovering position.

Caspian Tern (*Hydroprogne caspia*) Rare visitor to ponds and reservoirs, where it feeds in a manner similar to Forster's tern.

Band-tailed Pigeon (*Columba fasciata*) Uncommon visitor and breeding resident of the broadleaf sclerophyll forest. Acorns are an important part of this bird's diet.

Rock Dove (*Columba livia*) Common breeding resident of residential areas, farms, and towns; not a native to California; commonly known as the "pigeon"; it feeds on ground seeds and grains.

Mourning Dove (*Zenaida macroura*) Common breeding resident of woodland and residential-farm areas; a ground seed eater; the number one game bird in California

Barn Owl (*Tyto alba*) Uncommon breeding resident; nests mainly in old buildings and barns; forages at night for small rodents in open grassland and pasture areas.

Screech Owl (*Otus asio*) Uncommon-to-rare breeding resident; nests in tree holes in broadleaf sclerophyll forest; feeds on small mammals (usually mice) and larger insects taken in and around forest areas.

Great Horned Owl (*Bubo virginianus*) Common breeding resident of the broadleaf sclerophyll forest; forages for small mammals (up to jackrabbit size) at forest edge and in clearings in the forest, coastal scrub, and open grassland; this is another major rodent control predator which is highly dependent on stands of mature woodland for its survival.

White-throated Swift (*Aeronautes saxatalis*) Uncommon visitor, primarily during summer; forages high over many habitats in the hill area for flying insects.

Anna's Hummingbird (*Calypte anna*) Common breeding resident of the coastal scrub, riparian woodland, and residential areas; nectar from various flowers (often red in color) provides most of the food along with some insects; no doubt this species is aided in its food supply by garden feeders; easily conditioned to window hummingbird feeders.

Rufous Hummingbird (*Selasphorus rufus*) Uncommon, transient during spring and fall migration; found wherever flowers provide an adequate food supply.

Allen's Hummingbird (*Selasphorus sasin*) Uncommon spring and early summer breeding visitor to riparian woodland and coastal scrub areas; similar to Anna's hummingbird in feeding.

Belted Kingfisher (*Megasceryx alcyon*) Uncommon-to-rare visitor to ponds, reservoirs and streams; feeds on small fish captured by diving from the air into the water, usually from a feeding perch at the water's edge.

Common (Red-shafted) Flicker (*Colaptes auratus*) Common breeding resident of the broadleaf sclerophyll forest and oak woodland; requires tree holes for nesting; unlike other woodpecker types, it forages on the ground, usually for ants.

Red-breasted Sapsucker (*Sphyrapicus ruber*) Uncommon-to-rare winter visitor to the broadleaf sclerophyll forest; feeds on tree sap and insects attracted to the sap.

Downy Woodpecker (*Dendrocopos pubescens*) Uncommon breeding resident of the broadleaf sclerophyll forest; digs holes in trees to provide nesting sites; feeds on bark-dwelling insects.

Nuttall's Woodpecker (*Dendrocopos nuttalli*) Common breeding resident of the broadleaf sclerophyll forest and oak woodland; nests in holes which it digs in the tree trunks; feeds primarily on bark-dwelling insects.

Western Kingbird (*Tyrannus verticalis*) Uncommon spring and summer visitor and possible rare breeding visitor to open woodland and farms; feeds on flying insects by flying out to catch them from a low perch.

Ash-throated Flycatcher (*Myiarchus cinerascens*) Uncommon spring and summer breeding visitor to broadleaf sclerophyll forest, riparian woodland, and coastal scrub; nests in tree holes made and abandoned by woodpeckers; feeds primarily on flying insects, which it catches by flying out from a perch.

Black Phoebe (*Sayornis nigricans*) Common breeding resident around ponds, reservoirs, and streams; nests are often placed in culverts or other man-made structures near water; feeds on low-flying insects over water.

Say's Phoebe (*Sayornis saya*) Uncommon-to-rare winter visitor to grassland, oak woodland, and ranchland; feeds on low-flying insects from a perch takeoff site.

Western Flycatcher (*Empidonax difficilis*) Uncommon transient and spring-summer breeding visitor to the broadleaf sclerophyll forest; nest is often placed on crossbeams under cover of man-made objects, on steep banks, or in shallow, partially-hidden tree cavities; feeds on flying insects beneath the forest canopy.

Western Wood Pewee (*Contopus sordidulus*) Uncommon spring and summer breeding visitor to openings in the broadleaf sclerophyll forest; feeds on flying insects.

Horned Lark (*Eremophila alpestris*) Uncommon breeding resident or winter visitor to areas of extensive short grass or open ground; like the California ground squirrel, this is one of the few species which benefits from overgrazing practices; feeds on seeds and insects.

Violet-green Swallow (*Tachycinetta thalassina*) Common spring-through-fall transient; forages on flying insects over all habitats.

Tree Swallow (*Iridoprocne bicolor*) Uncommon spring-through-summer transient; similar to violet-green swallow in feeding.

Barn Swallow (*Hirundo rustica*) Common spring-summer breeding visitor and transient; nests where mud is available for nest building material; nests are often constructed under cover of building ledges, bridges, etc.; similar to violet-green swallow in feeding.

Rough-winged Swallow (*Stelgidoteryz ruficellis*) Uncommon spring-through summer transient; similar to violet-green swallow in feeding.

Cliff Swallow (*Petrochelidon pyrrhonta*) Common spring-summer breeder, either as a visitor or transient; nests in colonies wherever mud is available; builds mud nests under bridges or under ledges on buildings; feeding similar to that of the violet-green swallow.

Steller's Jay (*Cyanocitta stelleri*) Common breeding resident of the broadleaf sclerophyll forest; feeds on a large variety of plant and animal matter including small mice, nesting birds, lizards, and salamanders.

Scrub Jay (*Aphelocoma coerulescens*) Common breeding resident of the coastal scrub and oak woodland; similar to the steller's jay in feeding habits, except feeding site is different.

Common Crow (*Corvus brachyrhynchos*) Common visitor and occasional breeding resident of ranchland and oak woodland; may occasionally take up large, communal roost trees in an area; feeds in open areas on a large variety of items.

Chestnut-backed Chickadee (*Parus rufescens*) Common breeding resident of the broadleaf sclerophyll forest and wooded residential areas; nests in natural or woodpecker-evacuated holes; feeds on foliage-dwelling invertebrates of trees and shrubs.

Plain Titmouse (*Parus inornatus*) Common breeding resident of the broadleaf sclerophyll forest, riparian woodland, and wooded residential areas; feeds on tree- and shrub-dwelling invertebrates.

Brown Creeper (*Certhia familiaris*) Common visitor and possible breeder in the broadleaf sclerophyll forest; nest is placed under the loose bark of a tree; feeds on trunk-dwelling invertebrates.

Wrentit (*Chamaea fasciata*) Common breeding resident of coastal scrub and thick riparian thickets; feeds on shrub-dwelling invertebrates.

Bushtit (*Psaltiriparus minimus*) Common breeding resident of broadleaf sclerophyll forest, riparian woodland, and wooded residential areas; feeds on tree- and shrub-dwelling invertebrates.

House Wren (*Troglodytes aedon*) Uncommon spring-through-fall visitor and possible breeder in scrubland and forest-scrub edges; feeds on invertebrates found in trees and shrubs.

Bewick's Wren (*Thryomanes bewicki*) Common breeding resident of the coastal scrub and riparian thicket; feeds on tree- and scrub-dwelling invertebrates.

Mocking Bird (*Mimus polyglottos*) Common breeding resident of ranchland and residential areas; feeds on insects and fruit.

California Thrasher (*Toxostoma redivivum*) Uncommon breeding resident of the coastal scrub and riparian thicket; feeds on ground-dwelling invertebrates.

American Robin (*Turdus migratorius*) Common breeding resident and visitor to the broadleaf sclerophyll and residential areas; feeds on ground-dwelling invertebrates and fruits of shrubs.

Varied Thrush (*Ixoreus naevius*) Common winter visitor to the broadleaf sclerophyll forest; feeds on ground-dwelling invertebrates.

Hermit Thrush (*Catharus guttatus*) Uncommon transient or winter visitor to all hill habitats except grassland; feeds on ground-dwelling invertebrates and fruits of shrubs.

Swainson's Thrush (*Catharus ustulatus*) Uncommon spring-summer visitor and non-breeding transient of the broadleaf and riparian forests; feeds on invertebrates found on the ground and in low vegetation.

Western Bluebird (*Siala mexicana*) Uncommon breeding resident of forest edge and scrub habitats; nests in a natural or woodpecker-made tree hole; feeds on ground invertebrates.

Ruby-crowned Kinglet (*Regulus calendula*) Common fall-through-spring visitor to broadleaf and riparian woodland and wooded residential areas; feeds on tree-dwelling invertebrates.

Water Pipit (*Anthus spinoletta*) Common fall-through-spring visitor to ranches, grazed land and lawns; feeds on invertebrates and ground seeds.

Cedar Waxwing (*Bombycilla cedrorum*) Moderately common winter visitor to any area where small fruits and berries are available.

Loggerhead Shrike (*Lanius ludovicianus*) Common breeding resident of open scrub and woodland, also in ranchland, where fence posts are used for feeding perches; feeds on large insects and occasionally on small vertebrates.

Starling (*Sternus vulgaris*) Common introduced breeding resident of woodland, ranches, and residential areas; nests in holes in buildings or those made by woodpeckers; eats seeds and ground invertebrates.

Hutton's Vireo (*Vireo huttoni*) Common breeding resident of the broadleaf sclerophyll forest; feeds on invertebrates, primarily in live oak trees.

Warbling Vireo (*Vireo gilvis*) Common spring-summer breeding visitor to broadleaf forest and riparian woodland; feeds on tree-dwelling invertebrates in the upper canopy.

Orange-crowned Warbler (*Vermivora celata*) Common spring-summer breeding visitor to broadleaf and riparian woodland and coastal scrub; feeds on tree- and shrub-dwelling invertebrates.

Audubon's or Yellow-rumped Warbler (*Dendroica coronata*) Common spring-summer breeding visitor to broadleaf and riparian woodland and coastal scrub; feeds on tree- and shrub-dwelling invertebrates.

Black-throated Gray Warbler (*Dendroica nigrescens*) Uncommon spring- and summer-through-fall transient of the broadleaf and riparian woodland; feeds on tree- and shrub-dwelling invertebrates.

Townsend's Warbler (*Dendroica townsendi*) Uncommon fall and spring transient and winter visitor of the broadleaf forest; feeds on tree-dwelling invertebrates.

Macgillivray's Warbler (*Oporornis tolmiei*) Uncommon-to-rare spring and fall transient of riparian thickets and coastal scrub; feeds on tree- and scrub-dwelling invertebrates.

Wilson's Warbler (*Wilsonia pusilla*) Uncommon spring-summer breeding visitor, and spring and fall transient of broadleaf and riparian woodland; feeds on tree- and shrub-dwelling invertebrates.

House Sparrow (*Passer domesticus*) Common introduced breeding resident of farms, towns, and residential areas; feeds on seeds and insects from the ground.

Western Meadowlark (*Sturnella neglects*) Common breeding resident of grassland and ranch pasture; feeds on ground- and grass-dwelling invertebrates, and seeds.

Red-winged Blackbird (*Agelaius phoeniceus*) Common breeding resident of cattail areas near ponds, and tall mustard stems in grassland; feeds on insects and seeds in open fields and farmland situations.

Hooded Oriole (*Icterus cucullatus*) Uncommon spring-summer breeding visitor to residential areas, where palm fans are used for nest sites; feeds on bottlebrush plants and also on insects in low-growing vegetation.

Bullock's or Northern Oriole (*Icterus galbula*) Uncommon spring-summer breeding visitor of riparian woodland; feeds on insects and fruits obtained from vegetation.

Brewer's Blackbird (*Euphagus cyanocephalus*) Uncommon breeding resident of grassland and scrub near water; also a common winter visitor; forages in large flocks in grassland, ranchland, and residential areas; feeds on insects and seeds obtained on the ground.

Brown-headed Cowbird (*Molothrus ater*) Uncommon breeding resident of riparian woodland and common visitor to farm-ranch areas; lays eggs in the nests of other species, which then raise these young; feeds on seeds and invertebrates obtained on the ground.

Western Tanager (*Piranga ludoviciana*) Uncommon spring and fall transient in broadleaf forests, orchards, and wooded residential areas; feeds on invertebrates of the tree canopy, and also domestic and wild fruits.

Black-headed Grosbeak (*Pheucticus melanocephalus*) Common spring-summer breeding visitor of broadleaf forest; feeds on fruits, seeds, berries, and insects.

Lazuli Bunting (*Passerian amoena*) Uncommon spring-summer breeding visitor to scrubland ravines; feeds on fruits, seeds, and invertebrates obtained in low vegetation.

Purple Finch (*Carpodacus mexicanus*) Uncommon breeding resident or visitor of the broadleaf forest; feeds on seeds, buds, and fruit.

House Finch (*Carpodacus mexicanus*) Common breeding resident of oak woodland, coastal scrub, and residential and farm areas; feeds on seeds and fruits of herbs and shrubs.

Pine Siskin (*Spinus pinus*) Uncommon-to-common winter visitor to open woodland and ranch-farm areas; feeds on weed seeds.

American Goldfinch (*Spinus tristis*) Uncommon breeding resident of riparian thickets and visitor to grassland and farms; feeds mostly on seeds and buds.

Lesser Goldfinch (*Spinus psaltria*) Common breeding resident of the forest-scrub edge and riparian woodland; feeds on seeds and buds.

Rufous-sided Towhee (*Pipilo erythrophthalmus*) Common breeding resident of coastal scrub and riparian thickets; feeds on insects and seeds found by scratching in leaf litter.

Brown Towhee (*Pipilo fuscus*) Common breeding resident of woodland, coastal scrub, and residential areas; feeds on ground insects and seeds.

Savanna Sparrow (*Passerculus sandwichensis*) Uncommon-to-rare breeding resident and winter visitor of the grassland; feeds on ground insects and seeds.

Rufous-crowned Sparrow (*Aimophila ruficeps*) Uncommon breeding resident of California sagebrush scrubland; feeds mostly on ground seeds.

Dark-eyed (Oregon) Junco (*Junco hyemalis*) Uncommon breeding resident and common winter visitor of broadleaf forest; feeds on open ground, near cover of trees, on seeds and insects.

Lark Sparrow (*Chondestes grammacus*) Uncommon spring-summer breeding visitor to open woodland and grassland; feeds on insects and seeds found on ground.

Chipping Sparrow (*Spizella passerina*) Uncommon-to-rare spring-summer visitor of open woodland and grassland; feeds on ground seeds and insects.

White-crowned Sparrow (*Zonotrichia leucophrys*) Common winter visitor to coastal scrub and shrubs in residential areas; feeds mostly on seeds obtained from the ground.

Golden-crowned Sparrow (*Zonotrichia atricapilla*) Common winter visitor to coastal scrub and shrubs in residential areas; feeds on seeds obtained on the ground.

Fox Sparrow (*Passerella iliaca*) Uncommon winter visitor to low scrub areas in broadleaf forest, coastal scrub, riparian woodland, and oak woodland; feeds on seeds and insects obtained by scratching in leaf litter.

Lincoln's Sparrow (*Melospiza lincolni*) Uncommon fall-through-spring resident in riparian thickets and tall grassland; feeds on seeds and invertebrates obtained on ground.

Song Sparrow (*Melospiza melodia*) Common breeding resident of riparian thickets, coastal scrub, and residential areas; feeds on seeds and insects obtained from low vegetation and on the ground.

Total Number of Species: 117

Breakdown by Habitat*:

Broadleaf Sclerophyll Forest:	53
Riparian Woodland:	22
Coastal Scrub:	25
Grassland:	25
Ponds and Reservoirs:	28
Aerial:	9
Ranches and Farms:	33
Residential and Town:	20

Total Number of Breeding Species: 72

Breakdown by Habitat*:

Broadleaf Sclerophyll Forest:	42
Riparian Woodland:	13
Coastal Scrub:	8
Grassland:	15
Ponds and Reservoirs:	5
Aerial:	4
Ranches and Farms:	12
Residential and Town:	10

*Note: Breakdown numbers surpass total because many species may breed in two or more habitats.

Figure 2
Bird Summary List

SUMMARY OF HABITAT REQUIREMENTS

The Broadleaf sclerophyll forest has the richest avifauna of any of the habitats in the study area. Compared to other habitats, a larger number and proportion of the species which occupy this habitat also breed in it. Other habitats are more equal in the number of species which occur there, but differ in the proportion of species that also breed in them. In general, natural habitats have a higher proportion of breeding species than ranches, farms, and residential areas. Replacement of any natural, terrestrial habitat (except grassland) with a non-natural habitat would result in a decrease in the number of species that occur there.

Aquatic habitats host a large number of species which are found in no other habitat. However, most of these are of rare occurrence. Disappearance of these habitats would certainly result in the elimination of these species from the Hayward Hills area.

COMPATIBILITY WITH HUMANS

Of all the vertebrate groups, birds are, by far, the most compatible. First of all, their excellent defense mechanism of aerial escape has resulted in their close approach to humans to feed, display, rest, and even nest and raise offspring. They are, for the most part, diurnal, which makes for excellent observation. Indeed, no other group of animals has commanded such a following as far as human observers are concerned. Bird-watching is an ever-increasing, popular pastime among both young and old people, and an ever-increasing amount of money is spent each year on those items (such as binoculars, field guides, recordings, feeders), and other gear associated with the enjoyment of birds. Not only are birds a most pleasing and most visible part of the vertebrate community, but the vast majority of species in the hill area are carnivorous and consume large numbers of rodents and insects each year. Many of the fly and rat-mouse problems associated with cities results from the disappearance of the natural avifauna, due to complete habitat destruction. When this happens, we are left with just a few species in residential areas, and these are nearly always the least desirable, introduced forms, such as the starling, domestic pigeon, and English sparrow. As in all vertebrate classes, habitat preservation is vital for the persistence of this group, and it is safe to say that birds will be the most deeply missed by the majority of Hayward Hills residents, if these habitats are lost.



PLATE III

ALAMEDA STRIPED RACER
(*Masticophis lateralis euryxanthus*)

CHAPTER IV-THE REPTILES (Class *Reptilia*)

WESTERN POND TURTLE (*Clemmys marmorata*)

Habitat Requirements. The western pond turtle is our only native freshwater turtle in the west. It occurs in fair numbers in both Jordan Pond and Don Castro Reservoir. It prefers deeper water and a moderate abundance of aquatic vegetation. Therefore, "clean" stock ponds or small creeks are not likely sites for this form. It feeds on aquatic vegetation, live aquatic vertebrates, and carrion. A soft mud or sandy shore area is necessary for nesting.

Reproductive Biology. Females bury their eggs in moist, shoreline soil. Nesting takes place in June and early July, and the nest site must remain undisturbed through late summer, when the young hatch. It is very rare to find either a nest or baby pond turtles, and we believe that mortality is extremely high in both areas. This is, no doubt, compensated for by the unusually long life that all turtle species enjoy.

Relative Abundance. Jordan Pond contains perhaps a dozen adult western pond turtles, and Don Castro twice that many.

Compatibility with Humans. Pond turtles are extremely wary animals and, given a pond of adequate size (especially with adequate haul-out sites), they persist in the near presence of people. Dogs can be a destructive force on the nests, since they can detect them, though small, and dig them out. The turtle's role as a scavenger in ponds and lakes is vital to the overall balance of these aquatic communities.

WESTERN FENCE LIZARD (*Sceloporus occidentalis*)

Habitat Requirements. This reptile is a heliothermic or basking form, and requires sunny, exposed areas with rock outcroppings, wooden fences, fallen dead trees, or old barns and woodpiles. for retreats and sunning sites. Such items in open grassland and coastal scrub are ideal sites. Like most reptiles, it is seasonally active from early spring to mid-fall. It feeds on a wide variety of insects and other invertebrates, which it catches by either active foraging through the grass and brush, or by darting out from a feeding perch.

Reproductive Biology. Males are territorial, and display atop fence posts and rocks by exhibiting an interesting "push-up" type behavior. Females lay from 9 to 12 eggs in a covered subsoil nest in late spring. Eggs hatch in late summer without any parental care. Young grow rapidly and enter the winter hibernation period at about one-half the adult size.

Relative Abundance. This is the most abundant reptile in the hill area. It occurs virtually wherever the above habitat requirements are met. In areas of good rock outcrop, we have observed populations of at least 50 per acre, which rivals the densities of several mouse species.

Compatibility with Humans. The western fence lizard can coexist amicably with human habitation. If natural cover items do not exist or have been removed from the area, they do not thrive, however, since the modern dwelling provides little in the way of deep crevice retreats for this form. Because they are insectivorous, the fence or "blue-bellied" lizard joins with many bird species as an important natural control mechanism for many insect pests. Because they are diurnal, easily observed, and somewhat easily caught, this species (along with small amphibians) provides a child with his or her first real exposure to nature and natural pets. Along with their native bird counterparts, they provide the feeling and knowledge that some part of the natural scene still exists in and around a well-planned community. Domestic cats can be very detrimental to colonies of this lizard near residential areas. Like all reptiles in the study area, they are completely harmless to man.

SOUTHERN ALLIGATOR LIZARD (*Gerrhonotus multicarinatus*)

Habitat Requirements. This lizard lives at the edge of the broadleaf sclerophyll and riparian woodland, and within the oak woodland and coastal scrub areas. It spends much time under the leaf litter or other ground cover, occasionally emerging to bask and feed. It can climb well, and in addition to insects and soil invertebrates, it occasionally eats baby mice, birds, and bird eggs.

Reproductive Biology. Like the western fence lizard, this species lays eggs in late spring in moist subsoil nests. The young hatch in about two months. Both young and adults are far more active than the fence lizard during the winter months, because of a tolerance for lower temperatures.

Relative Abundance. The southern alligator lizard is far less abundant than the western fence lizard. We estimate densities of no more than one per acre in areas of prime habitat.

Compatibility with Humans. This is far more of a wilderness species than the western fence lizard. The specific requirements of its natural habitat are seldom met in lawn and garden situations. It is one of the many, relatively unnoticed reptiles of the hill natural community.

WESTERN SKINK (*Eumeces skiltonianus*)

Habitat Requirements. The western skink requires moist leaf litter, such as that occurring in the broadleaf sclerophyll and riparian woodlands, and coastal scrub, during the rainy portions of the year. As the litter dries out, the skink becomes quite scarce, apparently seeking out deeper retreats. It rarely appears in the open and, therefore, is seldom seen unless large rocks or logs are turned over. It feeds on a variety of soil invertebrates, including termites.

Reproductive Biology. Eggs are laid in moist portions of the leaf litter and in rotting logs. The young differ from the adult in that they have a brilliant blue tail. This bright tail color gradually fades until there is only a trace of it in the adult form. Like other lizards, the tail breaks easily when grabbed by a predator, thus allowing the skink to escape. It is thought that the bright blue juvenile tail directs a predator's attention to it, thus allowing escape after tail breakage.

Relative Abundance. This is the most secretive lizard in the study area, and the least abundant. We estimate a density of perhaps one per five acres of prime habitat.

Compatibility with Humans. Once again, we have here a scarce wild-land species. It is extremely susceptible to ground disturbance and, therefore, not usually found in garden areas.

SHARP-TAILED SNAKE (*Contia tenuis*)

Habitat Requirements. This small snake is found both at the forest edge and in open grassland, where good cover and surface moisture is available. It is active in spring and fall, but tends to avoid summer heat and dry periods by retreating below ground. Its diet consists almost entirely of slugs and, thus, the association with moist soil.

Reproductive Biology. Like most snakes in the hill area, the sharp-tailed snake depends on rodent burrows to provide sheltered, moist soil for the egg-laying site. Eggs are laid in late spring and hatch in late summer, when food in moist areas again becomes available.

Relative Abundance. The sharp-tailed snake appears common throughout those areas of prime habitat during the most favorable weeks of the spring and fall. We estimate roughly one sharp-tail per five acres.

RINGNECK SNAKE (*Diadophis punctatus*)

Habitat Requirements. This small snake is most often found under surface cover at the edge of riparian and broadleaf forest areas, but it will also venture into grassland to feed. It is most active in spring and fall and, like the sharp-tailed snake, avoids the hot, dry summer months by seeking cool subterranean retreats. It feeds on small salamanders (especially the California slender salamander), small frogs, young lizards, insects, and worms.

Reproductive Biology. This species appears to have the lowest potential natality of any snake in the study area. The maximum number of eggs reported in the literature is three (Stebbins, 1954). Eggs are usually laid in rodent burrows or some other underground retreat.

Relative Abundance. This is one of the least abundant snakes in the hill area, due (in part, no doubt) to its low reproductive rate. It seems to occur in small pockets of prime forest edge habitat with extensive physical ground cover. It is therefore difficult to place a number-per-acre estimate on this form.

Compatibility with Humans. Comments here apply to both the ringneck and the sharp-tailed snakes. They appear to hold the same relationship to humans as do the more secretive lizards of the forest floor. They rarely are found in or about human dwellings and yards and, thus, are rarely seen by people.

RACER (*Coluber constrictor*)

Habitat Requirements. This species prefers sunny south-facing slopes in grassland, coastal scrub, and open woodland. Abundant fence lizard populations are good indicators of their presence. They may also be found near ponds and creeks where frogs are present. They feed primarily on fence lizards, mice, and large insects (especially grasshoppers).

Reproductive Biology. This species possesses a high reproductive potential. Clutch size ranges from one to two dozen eggs. Nests are located in moist ground in moderately sunny areas, on the edge of grass and scrub habitats. Eggs are laid in June and July, and hatchlings appear in early September.

Relative Abundance. The racer is a common resident of the hill area. As its name implies, it is an extremely fast snake, and this, coupled with great alertness, makes for very few sightings, even though it is common. A probable density in prime habitat is one snake per five to eight acres. This number can increase greatly when the fall hatch occurs. Mortality is accordingly high, since the racer is exposed to heavy hawk predation, due to its exposure while moving and hunting in open grassland.

Compatibility with Humans. This is one of several large snakes of the Hayward Hills which acts as a major check on small rodent populations. It rarely wanders into residential districts. The racer is known for its aggressiveness, and usually bites the hand which tries to capture it. The bite is completely harmless and if the skin is broken, it should be treated like any scratch that one might receive while working outdoors.

ALAMEDA STRIPED RACER (*Masticophis lateralis euryxanthus*)

Habitat Requirements. This beautiful racer is found on south-facing slopes and ravines where shrubs (such as poison oak, California sagebrush, and sticky monkey flower) form a vegetative mosaic with oak trees and grasses. Unlike its near relative, the racer, the Alameda striped racer does not thrive in just grassland. The western fence lizard is the most important item in the diet of this snake. Hammerson, 1977, reports on several aspects of the physiological ecology of this snake which adapts it well to lizard feeding. It also eats frogs, small mice, and other small snakes.

Reproductive Biology. Mating occurs in April and May, and from six to ten eggs are laid in abandoned rodent burrows in June or July. Like the racer, the eggs hatch in early September.

Relative Abundance. The Alameda striped racer is officially classified as a rare species, which it is through most of its limited range in the greater Bay Area. In the Hayward Hills, however, it appears to be in fair abundance. We conclude that this area, perhaps more than any other, represents the best possible habitat conditions for this species. In the heart of such habitat, we estimate a density of from one to two snakes per ten acres.

Compatibility with Humans. Like other large snakes in this area, it provides the needed service of rodent control, though to a lesser extent than the racer or gopher snake. As our one vertebrate resident with the status of "rare and endangered", the protection of its habitat is extremely vital. Unfortunately, one of the most productive areas for this species has already been destroyed by the "bare earth" practices of the Challenge Development Company, just east of the Ecological Field

Station of California State University, Hayward. Ecotones, such as that required by the Alameda striped racer, are quite rare and must be preserved if the species is to survive.

GOPHER SNAKE (*Pituophis melanoleucus*)

Habitat Requirements. This is the largest snake found in the study area. It most commonly occurs in grassland, but is also found in scrub areas and along the woodland edge. It is our most avid rodent-feeding snake and takes gophers, meadow mice, house mice, ground squirrels, and woodrats. Lizards and bird eggs are also occasionally eaten (Stebbins, 1966).

Reproductive Biology. An average of nine eggs are laid in vacant rodent burrows in June and early July, and hatch in late summer. This larger species does not breed until about age three or four. Like the other large snakes which feed primarily in open grassland, their numbers are held in check by moderate hawk predation, particularly that by the red-tailed hawk.

Relative Abundance. The gopher snake is perhaps the most abundant snake in the Hayward Hills. Precise counts of snakes are very difficult, if not close to impossible. However, sightings of both adult and young gopher snakes over the past ten years by workers at the Ecological Field Station of California State University, Hayward have out-numbered those of any other species by at least two to one. A density of one adult gopher snake per five acres of prime habitat is, perhaps, conservative.

Compatibility with Humans. This harmless and beneficial snake is the species most often seen near residences in the Hayward Hills. Unfortunately, its ability to survive near human habitation is impaired, since it is mistaken by some to be a rattlesnake and is killed. Sometimes, the snake adds to this misbelief by rapidly vibrating its tail when disturbed. If this occurs in dry grass or leaves, the sound can actually be similar to that of a small rattler. (We have no reports or sightings of rattlesnakes in the study area and, if they do occur, are extremely rare here.) Along with the hawks and owls, the gopher snake is vital for rodent control, and it should be highly encouraged. Unfortunately, auto kills of this snake are high.

COMMON KINGSNAKE (*Lampropeltis getulus*)

Habitat Requirements. This snake is found in grassland, coastal scrub, and open woodland edge situations. It feeds on a wide variety of vertebrate prey, including rodents, lizards, snakes, the eggs and young of birds, and amphibians.

Reproductive Biology. The common kingsnake lays up to 12 eggs, usually in abandoned rodent burrows. Like other snakes in this area, the eggs hatch in late summer.

Relative Abundance. We classify this snake as moderately common in the hill area. It feeds more at dusk and during the early evening hours than the other large snakes and, therefore, direct observations and counts are far more difficult. A rough density estimate in prime habitat is one kingsnake per 20 acres.

Compatibility with Humans. Like all other snakes mentioned so far, the removal of good habitat around developments and the overgrazing of rangeland greatly reduces its numbers. Unlike the racers and, to some extent, the gopher snake, this reptile has an extremely gentle nature and is easily handled. It is a favorite among teachers for introducing snakes to students. This species also appears to wander far less than the gopher snake, and road kills are rather uncommon. Along with the two racers and the gopher snake, it acts as an important rodent control factor in the hill area.

WESTERN AQUATIC GARTER SNAKE (*Thamnophis couchi*)

Habitat Requirements. This is a snake of the pond, creek, and lake shore. It prefers open shore areas, which enables it to periodically warm itself to an appropriate operating temperature after feeding excursions in the cool water. It subsists primarily on treefrogs, tadpoles, and small fish. It is also one of the few predators known to occasionally eat a California newt, which has a very toxic skin poison. Good pond edge cover is also necessary for this snake and, thus, it is normally not found around muddy, clean-edged stock ponds.

Reproductive Biology. The garter snake is the only local snake which gives birth to living young. This practice usually provides good reproductive success, since live-bearing affords far more protection to the ova than egg-laying. The number of young per litter ranges from six to nine.

Relative Abundance. This species is very numerous where the proper habitat conditions are present. We have counted over 20 adult western aquatic garter snakes around the shore of a shallow one-acre pond, located in the southern portion of Garin Regional Park. Conversely, the dry acres of grassland surrounding the pond contain no garter snakes.

Compatibility with Humans. Like all aquatically-orientated vertebrates preservation of the few remaining shallow pond areas is essential. This reptile performs a similar function in shallow ponds to that which the western pond turtle does in larger, deeper ones.

WESTERN TERRESTRIAL GARTER SNAKE (*Thamnophis elegans*)

Habitat Requirements. This species inhabits open woodland, brush-covered hillsides, and grassland. Compared to the western aquatic garter snake, it is far less associated with water. It may, however, be found beneath streamside vegetation, in sunny areas.

Reproductive Biology. Like the aquatic species, this form also gives birth to live young, ranging from six to nine per litter. Births in both garter snake species usually occur in mid-summer.

Relative Abundance. This species is relatively uncommon in the hill area. It was captured only once during the course of this study, and only several times by workers at the Ecological Field Station over the past several years.

Compatibility with Humans. Its presence in grassland and shrub adds to the snake pressure on rodent populations, especially on small mice (like the house mouse).

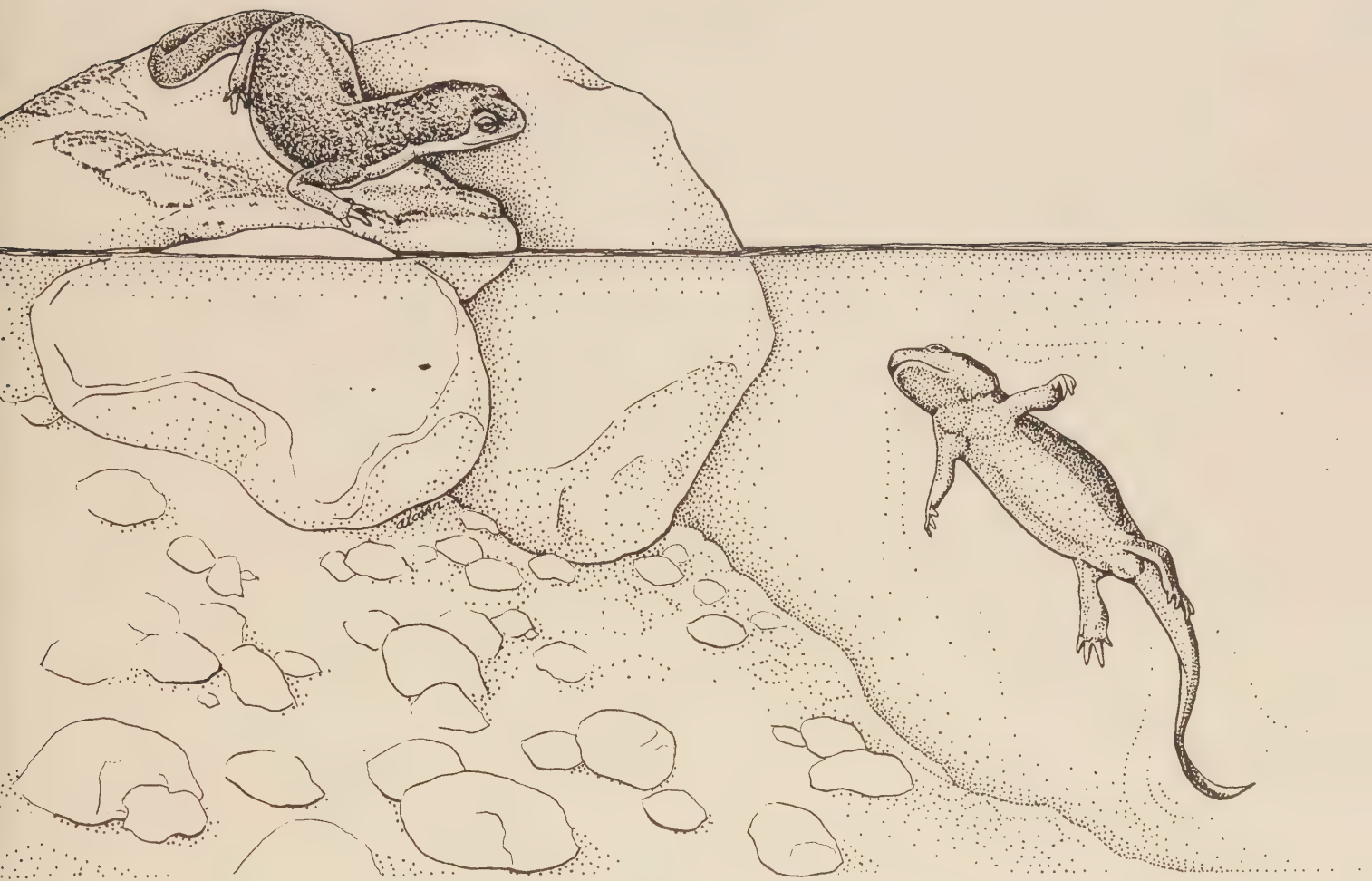


PLATE IV

CALIFORNIA NEWT
(*Taricha torosa*)

CHAPTER V - THE AMPHIBIANS (Class *Amphibia*)

CALIFORNIA NEWT (*Taricha torosa*)

Habitat Requirements. This is a water-breeding salamander and there must be a pond or a slow-moving stream somewhere within the home range of this animal. This home range can be quite large, however. In an extensive study of a breeding population of California newts in a shallow one-acre pond (located at the southern end of Garin Regional Park and hereafter referred to as the Newt Pond), tagged newts which bred in this pond were recaptured up to two miles away. They were observed to follow creek systems down to the pond and to retreat back up these canyons after breeding (Auza, 1969). Not all newts made the two-mile journey. The majority appeared to distribute themselves on the north-facing slopes of the canyons along the way. They seek out underground retreats in the moist soil and apparently remain in an inactive state throughout the warm, dry months of the year. Thus, the combination of both a breeding pond or stream, and abundant broadleaf sclerophyll and riparian forest, is essential for this species. They feed on a variety of soil invertebrates, especially worms and slugs. Most of the feeding apparently takes place during this active period, when the animals are moving above ground.

Reproductive Biology. Males emerge with the first heavy winter rains and migrate to the breeding pond, where they remain in an aquatic state for two to three months. Females do not make the breeding journey until the warmer rainy period begins in late January or February. Breeding and egg-laying take place throughout February and March, and then both sexes return to possible home areas on the north-facing slopes, where they remain sequestered until the next rainy season. This salamander lays its eggs in round clusters of about 16 eggs each. Usually no more than two clusters are deposited by a female. The clusters are attached to dead branches and roots of aquatic vascular plants. These items are an essential part of the breeding pond. This is a rather low number of eggs for an amphibian to lay. However, this species appears to be long lived for its size (10 years or more), and has no natural predators in this area (except the garter snake). This is apparently due to a rather potent toxin, secreted by glands in the skin. One has to ingest a newt, however, to be affected and, therefore, humans (except perhaps for very young children) are safe with this species.

The larva hatch in about three weeks, depending upon water temperature, and feed on pond invertebrates throughout the spring and early summer. They metamorphose in late summer and usually remain under available cover along the pond edge until the fall rains, when they are able to travel to aestivation sites on the nearby north-facing slopes. They do not breed during their first year of life.

Relative Abundance. The California newt is the most abundant amphibian in the study area, and one of the most abundant resident vertebrates in the Hayward Hills. During a peak breeding period in 1967, a marking study at Newt Pond on Garin Ranch recorded over 1600 newts (Auza, 1969). During the past two years, breeding has been all but suspended due to low rainfall. If sufficient rains do not fall and saturate the ground thoroughly, the California newt and other similar species apparently do not develop eggs and sperm during that season, nor are they stimulated to migrate. This is a very wisely designed system to conserve reproductive energy and use it only when good breeding and larval growth conditions are present. The long life of this species permits them to skip one or more breeding seasons without substantial injury to the population. Only five newts were captured in the breeding pond on two visits this year and very few egg clusters were seen. These were, perhaps, all from newts which aestivate on the edge of the spring seepage which feeds the pond.

Compatibility with Humans. This species can exist in close association with humans, as long as shallow ponds in areas with undisturbed canyon floors and north-facing slopes are preserved. Tampering with the watershed above such ponds can be disastrous to this and numerous other species. The "cemetery pond" and Zeile Creek, which feeds it, are prime examples of such destruction. The total clearing to loose ground of an entire hillside from the ridgeline to Zeile Creek by the Challenge Development Company, just south of the Ecological Field Station of California State University at Hayward, has caused continuing silt deposition in both the stream and pond bed. This has, in turn, destroyed the aquatic vegetation and is rapidly filling in the pond. We have carefully observed the newt population in this area before and during this destruction. There has been no successful breeding since the silting began and we now predict that, as this trend continues, the entire California newt population at the northern end of Garin Regional Park will eventually die out. This is indeed unfortunate, since this salamander is such an ideal animal for biology classes (from grade school on through our own university) to study and observe in their natural habitat. Unlike most other animals in the Hayward Hills, they congregate in large numbers to breed, are very easily observed, handled, and held in

captivity. Their eggs and resulting larva provide an exciting example of the phenomena of metamorphosis.

We have expanded the species account of this one salamander because it is well studied and is also an excellent example of how an extremely abundant animal can be all but eliminated from an area by one careless "development" procedure.

TIGER SALAMANDER (*Ambystoma tigrinum*)

Habitat Requirements. This is the only other pond-breeding salamander which may be found in greatly reduced numbers in the eastern portions of the East Bay hills. In the study area, we have not collected this species for several years, but they possibly still exist on some of the private ranchland. This salamander again needs a breeding pond, but is able to do far better than the California newt in stock ponds. They aestivate in deep rodent burrows in grassland surrounding such ponds. They feed on a variety of soil invertebrates during the migration and while breeding, stay in the pond.

Reproductive Biology. With the exception of the very long stay in the breeding pond by the males of this species, the timing and pattern of breeding is very similar to that of the California newt.

Relative Abundance. Although this species may still be found in small numbers in the Livermore hill areas, it is, no doubt, at the very edge of its habitat range on the east slopes of the study area. We suspect that a small population uses a stock pond on the Reed Ranch, east of Fairview Boulevard. However, with no breeding during this drought year, we have no direct evidence. They are definitely not found in either the Garin Regional Park Newt Pond or the pond above Holy Sepulchre Cemetery (Cemetery Pond).

Compatibility with Humans. Again, the same comments made for the California newt apply to this species, also. In addition, both species are quite susceptible to auto kills, where roads have been built through their migratory route. These kills take place on rainy nights, when the majority of movement takes place, and can be so numerous in the case of the newt that portions of the road become very slick, and motorists who come along later and attempt to brake for a wandering animal are in danger, as well. Several regional parks have posted "newt crossing" signs along such routes, in an effort to protect both species. We know of no such road in the study area where this problem presently exists.

CALIFORNIA SLENDER SALAMANDER (*Batrachoseps attenuatus*)

Habitat Requirements. This is the second most abundant salamander in the study area. It is one of three species of land-breeding salamanders which occur here, and thus the pond habitat is not necessary. It can live in a wide range of habitats, from dense broadleaf forest to open coast live oak woodland. However, moist ground conditions with abundant ground cover, such as rotting logs and large rocks, is essential. It is not found in grassland or coastal scrub areas. It is active under ground cover during the wet months, and then retreats to deep, underground retreats during the dry periods. It eats a variety of small ground invertebrates.

Reproductive Biology. This species lays a clutch of about 12 eggs in moist, protected areas, usually under rotting logs. Females have been found nest to the clutch with body contact with the eggs, in a presumed attempt to transfer body water to the eggs and prevent drying. There is no larval stage and, instead, fully developed miniature adults emerge. Several of these hatchlings can be placed on a dime, and they are perhaps the smallest example of a tetrapod vertebrate in the Western Hemisphere. Fertilization is internal, as is the case with all California salamanders.

Relative Abundance. As many as three to four of these animals may be found under one rock in prime habitat during the wet months. Densities of from one to two hundred per acre are not uncommon in prime habitat.

Compatibility with Humans. These are the most compatible salamanders in the study area. In some of the older residences, with backyards with plenty of ground cover and soil which has not been greatly disturbed, substantial populations can be found. The present home building practice of bulldozing the entire lot before construction negates this species before the yard is constructed. Like the California newt, this species is an excellent resource for field nature study.

YELLOW-EYED SALAMANDER (*Ensatina eschscholtzi xanthoptica*)

Habitat Requirements. This is also a ground-breeding salamander of the moist woodland floor. It requires more in the way of rotting logs than the slender salamander, and is rarely found under rocks. It feeds largely on termites and, thus, its association with rotting wood. Because of this, its prime habitat is the broadleaf forest and is rarely found in open oak woodland.

Reproductive Biology. Reproductive activities are nearly identical to those of the California slender salamander.

Relative Abundance. It is far less abundant than the slender salamander. The distribution is also quite sporadic, even in prime habitat. We estimate about one per acre under good conditions.

Compatibility with Humans. This species is much more of a wilderness form, and is not usually found in domestic situations.

ARBOREAL SALAMANDER (*Aneides lugubris*)

Habitat Requirements. This species of land-breeding salamander is far more closely associated with the coastal live oak woodland than the other two species. As the name implies, it occasionally climbs trees and seeks moist retreats in rotting cavities. It feeds on a variety of ground- and tree-dwelling insects and invertebrates. Once again, termites are high on its preference list.

Reproductive Biology. Similar to that of the other two land-breeding salamanders, the clutch is often laid in moist, rotting areas up in the tree, proper.

Relative Abundance. The Hayward Hills do not present many areas where oak woodland is closely associated with good ground moisture conditions and, thus, this is the least abundant of the land-breeding salamanders.

Compatibility with Humans. This species has been found in old, established garden conditions where live oaks and moist ground cover is present. This is the only salamander that is occasionally taken by cats. This is perhaps due to its more exposed, above-ground movement. It can be a very effective force in keeping termite infestations at a minimum in live oak trees and, thus, exhibits a nice example of symbiosis.

PACIFIC TREE FROG (*Hyla regilla*)

Habitat Requirements. This small frog may be found in all habitats within the study area where water, in the form of lakes, ponds, or quiet streams, is available throughout the spring breeding season, and where some sort of moist vegetative cover is in abundance along the shore. It feeds on a variety of small insects and ground invertebrates.

Reproductive Biology. Males come to breeding waters in early spring, and vocalize on all mild nights which, in turn, attracts the females. Egg masses of about two dozen eggs are laid in shallow water. Eggs hatch in two to three weeks and tadpoles

metamorphose in about one month, depending on water temperatures. Tadpoles are vegetarians and, therefore, do not compete with larval salamanders, which may also be in the pond at the same time. Metamorphosed young remain around the pond edge, where they feed on small insects and grow rapidly to adult size by the end of the summer.

Relative Abundance. During the first weeks of this study, in late May, we conducted a population survey in the Newt Pond in Garin Regional Park by continuously capturing tree frogs and marking them by toe clipping, so that they are counted only once. We recorded 120 Pacific tree frogs in this one acre pond during the second two weeks of May, 1977, and of these, 85% were males. We can, thus, conclude that a breeding population of at least 200 exists in this area, since females leave the pond after egg-laying but males remain. This is, by far, the most abundant anuran or frog-toad type amphibian in the study area but, again, populations are localized and dependent on standing water.

Compatibility with Humans. Along with bird species, the Pacific tree frog adds a pleasant vocal dimension to nearby residential communities. It is capable of living in garden situations, as long as there is some breeding water available in spring. A garden pond makes an excellent site for breeding. Like the California newt and California slender salamander, this species provides excellent field study opportunities for young and old naturalists alike, and is often a child's first pet.

RED-LEGGED FROG (*Rana aurora*)

Habitat Requirements. This is our largest nestive frog and it inhabits ponds in or near wooded areas. It is a permanent pond resident and, therefore, year around water of sufficient depth is necessary for its survival. Stock ponds are usually not suitable, since they are normally void of vegetative cover. It feeds on a variety of insects associated with the pond habitat.

Reproductive Biology. It breeds during the late spring months. Unlike the Pacific tree frog, it is mute for all intents and purposes. Egg masses may contain anywhere from 750 to 4,000 eggs. Young hatch in late spring and metamorphose in mid-summer.

Relative Abundance. The numbers of red-legged frogs throughout California have greatly decreased during the past several decades, due to the introduction of the non-native bullfrog into its pond habitat. The bullfrog is a larger species and extremely voracious in its feeding. It literally eats any live animals, with the possible exception of the California newt, which it can get down

its throat. This includes smaller members of its own species, as well as the red-legged frog. We, thus, believe the bullfrog is out-competing the red-legged frog by simply eating it up. Recent experiments with red-legged tadpoles during the course of this study indicate that they are far more susceptible to oxygen scarcity caused by pollution of pond habitats. In contrast, bullfrog tadpoles seem relatively unaffected by low oxygen levels. We estimate that no more than a few dozen red-legged frogs remain in the permanent aquatic habitats of the study area.

Compatibility with Humans. It seems that the combined human activities of bullfrog introduction and pollution have resulted in this species being the least compatible with human presence within the class *Amphibia*. At present, only a few individuals are in captivity at the Ecological Field Station of California State University at Hayward, and we hope to maintain a "survival colony" of them there.

BULLFROG (*Rana catesbeiana*)

Habitat Requirements. This species has been introduced into the west from the eastern portion of the United States. It is a pond frog and does well in any still or slow-moving water of moderate depth. As already mentioned, its habitat is exactly the same as that of the red-legged frog, to the great demise of the latter. The bullfrog feeds on just about any live matter which it can get into its mouth and swallow, with the possible exception of the California newt.

Reproductive Biology. This frog is quite vocal, and the presence of males can be detected by their deep, grating call on warm summer nights. Females lay from 10 to 20,000 eggs in early summer and, in this climate, the tadpoles take two years to reach metamorphosis.

Relative Abundance. The bullfrog now occupies all larger pond and lake habitats in the study area although, in habitats like Jordan Pond with abundant large fish populations, its numbers are kept way down. Other habitats, like the Newt Pond, appear far more suited to it, although numbers are still low in this area. Nowhere in the study area did we find a really thriving bullfrog, which is common in many other, nearby areas.

Compatibility with Humans. This is the only economically important species among the amphibians and reptiles in this area. Frog hunting is permitted with appropriate license, and should be encouraged, with the proviso that hunters are capable of distinguishing the red-legged frog from the bullfrog. A simple size limit, permitting only the largest frogs to be taken, would also

select for the removal of the bullfrog since it grows about twice as large as the red-legged frog.

WESTERN TOAD (*Bufo boreas*)

Habitat Requirements. This is the only species of toad in the study area and it requires a riparian edge situation which provides both moist retreats and open foraging areas. It feeds on a wide variety of large ground-dwelling invertebrate, particularly insects. Ponds for breeding must be available.

Reproductive Biology. Like the California newt, the western toad is capable of traveling some distance to a breeding site. Shallow ponds or slow-moving streams are the most desirable. Males are vocal, and their call directs females and other wandering males to the breeding site. Females may lay up to 16,500 eggs in two long strings, rather than clumps as with the frogs. Tadpoles metamorphose at a much smaller size than frogs of similar size, and then undergo rapid growth during the summer months. Periods of dispersal occur during the first fall rains.

Relative Abundance. Good riparian-grassland edge is somewhat limited throughout the study area and, thus, this species is only moderately abundant. We estimate densities of from one to three toads per acre in top wild habitat. It is possible to find higher densities in some well-vegetated gardens which are regularly watered and near a breeding site.

Compatibility with Humans. This amphibian is truly the gardener's friend. Where it is allowed to exist, in organic gardens where insecticides do not kill it, it easily may eat up to several hundred ground-dwelling insects, many of which are harmful to plants, in a single night. Like the California newt, this species also sustains a moderate road kill during periods of spring breeding migration and fall dispersal.



PLATE V

RIFFLE SCULPIN

(Cottus gulosus)

CHAPTER VI-THE FISH (Class *Pisces*)

The fish are unique among the vertebrates, in that only one native species has, up to a few years ago, persisted in its original habitat. Now we believe that it is gone. A few other species, native to California, are also present in the study area but in highly modified habitats. All other species are introduced from the eastern United States. We will, therefore, present full species accounts for the natives only, and cover the others by presenting a discussion of the species complex and habitat in which they occur.

NATIVE SPECIES

RIFFLE SCULPIN (*Cottus gulosus*)

Habitat Requirements. This is a small, native fish of the shallow streams of the Coastal Range. Its compressed body plan and large pectoral fins enable it to anchor behind or beneath large rocks in the stream bed and, thus, survive the periods of rapid flow during heavy winter rains. It feeds on a variety of bottom invertebrates.

Reproductive Biology. Spawning occurs in spring, after the heavy water flow is over. Eggs are scattered over gravel beds in the calmer portions of the stream. Young hatch within a few weeks and grow rapidly, so that they attain proper size to sustain the rapid fall water flow.

Relative Abundance. Prior to the activities of Challenge Development Company, on the south-facing slope and bed of Zeile Creek, just south of the Ecological Field Station of California State University at Hayward, there was a small but persistent population of these fish scattered throughout the lower reaches of the creek. They disappeared after the first massive silting of this stream, resulting from the bulldozing of the Challenge Development area, and to date we have not seen any more.

Compatibility with Humans. This fish is incompatible with any sort of massive stream destruction.

INTRODUCED SPECIES

SACRAMENTO BLACKFISH (*Orthodon microlepidotus*)

This is a native fish to California, but not to the study area. It is a large species of the minnow family, and originated in the Central Valley river systems. It was apparently introduced into Cemetery Pond, above Holy Sepulchre Cemetery, perhaps as a bait fish, and persisted in fair numbers up to this year. This was due, in part, to its filter feeding habits, since the pond is rich in phytoplankton and zooplankton. The low water levels of this drought year caused a considerable die-off and, at present, its population is greatly reduced. It is not considered a game fish, but instead acts as a prey species in the overall food chain. With the silting-in of this pond, its future in this area is guarded.

HITCH (*Lavinia exilicauda*)

This fish is also native to the Central Valley of California, and is a medium-size member of the minnow family. It was also probably brought into Cemetery Pond as a bait species. It feeds primarily on insects blown onto the surface of the pond, and also on aquatic vegetation. Its numbers have always been considerably less than that of the Sacramento blackfish. In its natural range, it prefers slightly warmer, more stagnant water than the blackfish, and there were no dead hitch recovered from the pond shore during the study period.

SPECIES NO LONGER IN STUDY AREA

Two other native California fish species also previously existed within the defined limits of the study area. These were the California roach (*Hesperoleucus symmetricus*) and the threespine stickleback (*Gasterosteus aculeatus*). These fish still persist in good numbers in San Lorenzo Creek, below the Don Castro Reservoir Dam and spillway. The formation of the reservoir, however, has completely negated the creek habitat, and these species have not adapted to lake conditions. The rainbow trout (*Salmo gairdneri*) also persisted in San Lorenzo Creek until recently, but the decreased water flow and increased pollution of the past decade has caused its disappearance.



PLATE VI

Don Castro Reservoir

CHAPTER VII - SPECIAL ECOLOGICAL SITES

DON CASTRO RESERVOIR

Don Castro Reservoir is the largest body of water in the Hayward Hills study area, approximately 15 acres in total surface area. It is shallower than most reservoirs in this area, and has a moderately wide inshore zone which makes for better fish productivity. All fish species now in the lake have either been introduced as game species or accidentally released as bait species. They are as follows:

GAME SPECIES

- large mouth bass
- channel catfish
- bluegill
- black crappie
- brown bullhead
- green sunfish

BAIT AND ROUGH SPECIES

- carp
- goldfish
- golden shinner
- mosquito fish

Because of the size of this lake, and the relatively short study period, an in-depth study was not undertaken. Instead, most of our information came from a fisherperson survey and shoreline dip netting. From the fair size of the panfish taken, however, we tentatively conclude that this lake is in fairly good ecological shape, compared to the average reservoir, which tends to produce an abundance of stunted fish after its initial filling period. This is probably due to the good fishing pressure it receives. Constant cropping of adult gamefish is about the only way in which reservoirs with multiple panfish species can avoid the overpopulation-stunting syndrome. So far, Don Castro has avoided this fate, and fishing should be continuously encouraged.



Figure 3

Northern Special Ecological Sites



Figure 4

Southern Special Ecological Sites

JORDAN POND (GARIN REGIONAL PARK)

Jordan Pond was formed several decades ago by the damming of Dry Creek, and covers approximately three and one-half acres. It is approximately 20 feet deep during high water conditions, and is presently 8 to 9 feet at its deepest, at the end of this drought year. Most of the shoreline is rather steep, but the inlet end has enough of a shallow zone for spawning and young fish foraging.

We seined this pond four times with a 100-foot-long, 6-foot-deep, $\frac{1}{4}$ -inch mesh beach seine, and caught approximately 350 fish of the following species:

- large mouth bass
- bluegill
- redeer sunfish
- brown bullhead

The largest fish taken was a 19-inch, 4-pound bass. There were also several 2-pound specimens and approximately 15 one to one and one-half pound bass. By far the most numerous species were the bluegill and the redear sunfish. The largest specimens of both species captured were one-fourth pound and five inches total length. This is well below maximum growth for either of these fish, and the great abundance of smaller redears and bluegills point to an overpopulation of these panfish, to the extent that stunting has occurred. By this process, the biomass of a fish species remains essentially the same, but more individuals of a sub-maximal size compose the population. Although a top predator, the bass is present in moderate numbers, it is apparently unable to adequately control the mushrooming populations of too-fast reproducing prey fish. This is reasonable, since Jordan Pond was privately owned until recently and, no doubt, received very little fishing pressure. Since the area was taken over by the Regional Park District, it has not been open to fishing, and the present stunting trend will no doubt continue.

CEMETERY POND

The pond located above Holy Sepulchre Cemetery is about one-half acre in size and about eight feet deep during high water. It is the smallest pond in the study area that is known to support a fish population. The species list for Cemetery Pond is as follows:

- bluegill
- black crappie

Sacramento blackfish
hitch
golden shinner
mosquito fish

All of these species, except the hitch and mosquito fish, appear to be stunted as a result of rather severe overcrowding. The greatest problem facing this habitat, however, is not too many fish but siltation, caused by upstream erosion above Zeile Creek on the Challenge Development land.

NEWT POND (GARIN REGIONAL PARK)

This pond is also one-half acre in area, but contains no fish. As previously mentioned, it is a key portion of Garin Regional Park and vitally necessary for numerous species, especially the pond breeders. Over the past decade, we have noticed this pond getting progressively shallower, however, and although the western portion of the pond contained up to two feet of water late this summer of 1977, the eastern portion (which is first to receive the flow from Dry Creek during the winter months) is dry (Plates IX and X). This is due to natural siltation, and both ends of the pond should be deepened by about two feet. This would double the available aquatic habitat, and increase the numbers of many of the species dependent upon it.



PLATE VII
Jordan Pond



PLATE VIII

Cemetery Pond



PLATE IX

Dry Upper Portion of NOWA. 10000



PLATE X

Lower Portion of Newt Pond

CHAPTER VIII - ECOLOGICAL RELATIONSHIPS

A detailed study of all the ecological relationships which exist between vertebrate species in this study would go far beyond the time allotment for this work. However, by looking at just a few of the apparent food chains or webs, we can easily see the inter-relationships which exist between species, and how the elimination of one member of a community can greatly effect the others.

Figure 5 illustrates the basic diurnal grassland food web as it exists in the Hayward Hills. Note first that the California meadow mouse is a key species in this complex. Because of its smaller size and exposure on the surface, it is available to all of the major diurnal grassland predators. Size or specialized defensive habits tend to limit such availability. The pocket gopher can only be taken with any real degree of success by either a "wait and pounce" predator, like the feral cat (which grabs the gopher as it exposes its head and neck during the tunnel dirt removal process) or the gopher snake, which can go down the tunnel after its prey. The snake is also effective at seeking out young California ground squirrels in their tunnels, but the keen eyesight and good view available to the ground squirrel all but negates the cat as a serious predator. Conversely, blacktail jackrabbits may be caught by cats, but are normally too large to be successfully handled by snakes. The method of hunting employed by the red-tailed hawk makes it the most universal predator of the diurnal grassland, and even incorporates another diurnal predator, the snake, among its prey. On the other hand, smaller body size and the technique of hunting from a hovering perch restricts the white-tailed kite to an exclusive diet of meadow mice. A shift in the availability of any one prey item in this web in turn determines the abundance of its predators. During periods of peak meadow mouse population, the situation is about as pictured in Figure 5. However, when this key prey species is at a low ebb in its four year population cycle, the red-tailed hawk, gopher snake, and feral cat now apply more predation pressure on the non-cyclic species, while the white-tailed kite, a meadow mouse specialist, leaves the area all together to seek out other meadow mouse populations in the peak years of their cycle.

The nocturnal grassland food web is more complex (Figure 6). This is because the majority of both prey and predatory mammals are nocturnal. In this case, the heavy predation pressure placed upon the meadow mouse during the day is buffered by the harvest

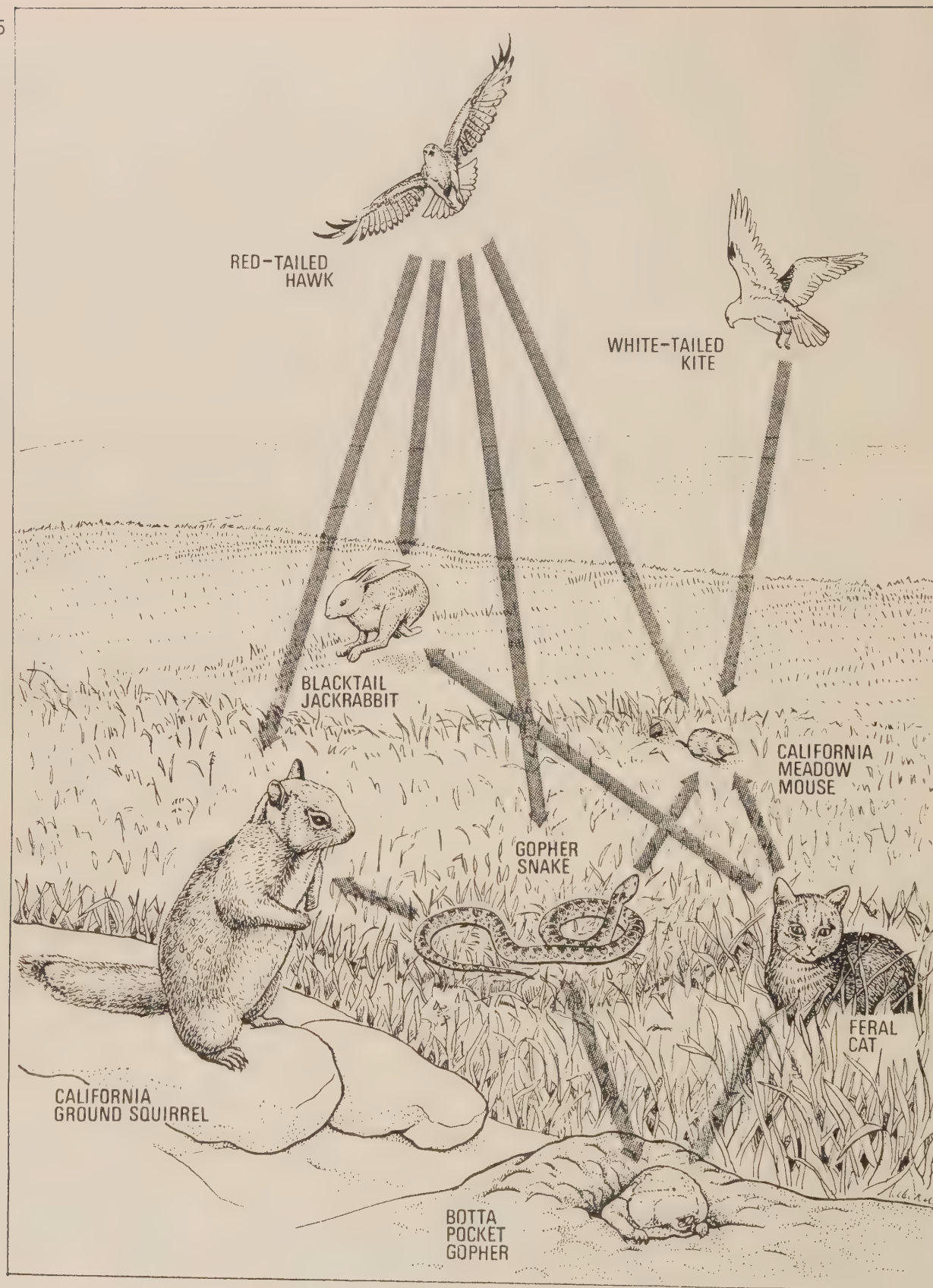


Figure 5

Grassland Food Web: Diurnal

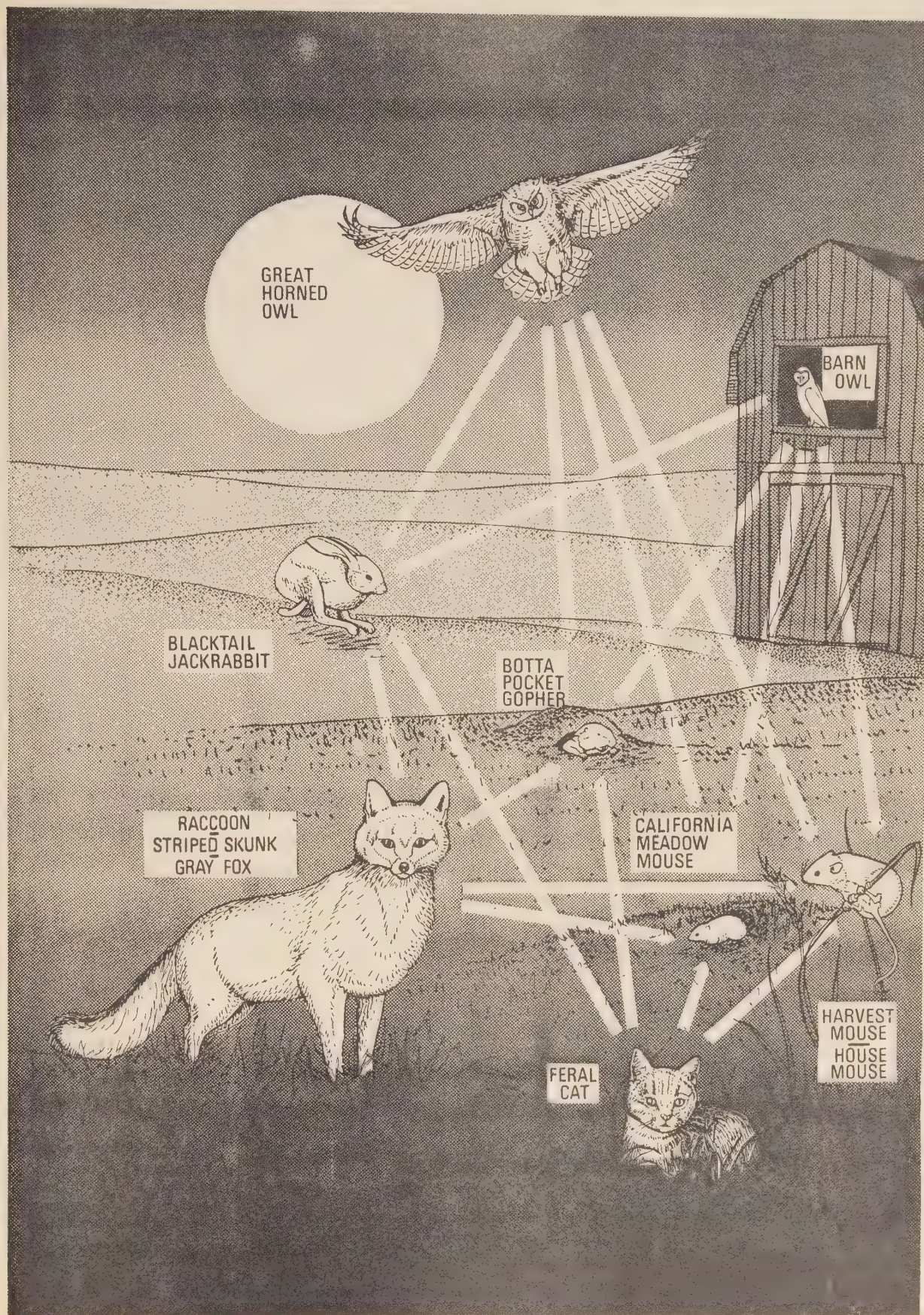


Figure 6

Grassland Food Web: Nocturnal

mouse and house mouse. This does not necessarily mean a greater abundance of food for owls (which have now replaced the hawks), because a spectrum of wild mammal predators (such as the grey fox, raccoon, and striped fox) now join the predator ranks.

A change in habitat usually means a complete change in prey species, since these are the forms which are highly adapted to the available plant food supply. Thus, we see in Figure 7 that the deer mouse and dusky-footed woodrat replace the California meadow mouse in the center of the food web. Some familiar faces are still present among the nocturnal mammalian predators, but the hawks and the open-land owl (the barn owl) have been eliminated from the aerial predator list by the dense tree cover. Only the great horned owl, which is skilled at flying among the lower branches of large trees, remains. The fox squirrel is in a somewhat unique position, in that it receives relatively little predation (except at dawn and dusk), and also acts as a predator, itself, on nestling birds and eggs.

The major point to bear in mind with respect to all food webs is their fragile nature. Like the spider web from which their graphic design is taken, they are delicate structures. The removal of any key strands, through habitat destruction and other undesirable human practices, can cause a total collapse. Most people enjoy seeing a majestic red-tailed hawk soaring over the countryside and will defend its preservation vigorously. The same folks may not think too much of a mouse and never give this creature's well-being a second thought. However, the hawk is there only because of the presence of the mouse, and mice can persist only if the habitat is preserved.

It is on this theme of habitat preservation that this report shall close. In the last few pages we shall discuss several practices which are especially detrimental to wildlife, and suggest some alternatives.

Figure 7

Woodland Food Web



PLATE XI

Land Clearing Activities North of the University

CHAPTER IX - HABITAT-WILDLIFE PRESERVATION

SUGGESTIONS

PRESERVATION OF THE LOWER WATERSHED. Lower watershed preservation on both north- and south-facing slopes is perhaps the most important single factor in preserving the wildlife communities of the Hayward Hills. The activities of the Challenge Development Company, in the area just south of the Ecological Field Station of California State University at Hayward, are a graphic illustration of just how detrimental watershed destruction can be. The land has been completely cleared, starting from the west side of Zeile Creek and extending across it and all the way up the south-facing slope. This has resulted in:

1. Complete destruction of riparian woodland, coastal scrub, and grassland communities in that area (Plate XI).
2. The siltation of Zeile Creek below the construction area and, as a result of this, the disappearance of all vertebrate life and most invertebrate and plant life from this habitat, including the last population of our only native fish in this area.
3. The siltation and eventual filling of Cemetery Pond.
4. The disruption of the movements of deer and predators between the natural areas occurring on either side of this swath.

This particular example of habitat destruction is especially unfortunate, in that it occurs directly adjacent to the land owned by the Research Foundation of the University. California State University at Hayward is the only university in the State with a wild area directly adjacent to the campus which is preserved solely for nature study and enjoyment. The Ecological Field Station is also a unique feature among state universities, and was placed in this area to further the study of the ecology of the coastal hills. Its function, and that of the wildlife area, has been greatly curtailed by the land use policies of its neighbor. The overall effectiveness of the new Garin Regional Park has also been greatly lessened in this area.

This is not to say that homes should not be built in the Hayward Hills. It is a beautiful place to live and should not be denied to the people of this community. However, its beauty is greatly decreased when the habitat is destroyed. Instead, what should be denied to developers are those several hundred feet of riparian woodland and coastal scrub community adjacent to a creek bottom.



PLATE XII

An Example of Good Hill Development

UPPER-SLOPE HOME CONSTRUCTION. By restricting home building to the upper slopes and ridgelines in the Hayward Hills, all of the problems seen in the previous example can be avoided. The lower watershed is preserved and, thereby, can serve as corridors for wildlife movement. By building only halfway down a slope, enough grassland or broadleaf forest may be preserved below to still permit thriving wildlife populations unique to these habitats. The wildlife survey conducted among upper-slope residents, along Fairview Boulevard and adjacent streets, gives support to this idea. Deer and quail were commonly seen, usually on a daily basis, and many secretive mammals, never observed during this study, were also reported.

Road construction is also far easier on the ridgelines, and side roads need be extended only as far as the upper-slope communities, and need not disrupt the lower watershed. Well designed upper-slope homes which adjoin natural communities provide their owners with the unique experience of living next door to nature (Plate XII). In contrast, by leap-frogging development in concentric rings down a hillside, the natural aspect of the community is lost. The small amount of modified grassland left between strips of houses in Plate XIII is not sufficient to support wildlife populations.

PRESERVATION OF HABITAT CORRIDORS AND ISLANDS. The preservation of continuous strips of natural habitat at least several hundred feet wide, which run between human communities and connect larger tracts of natural habitat, is necessary for the preservation of many of the larger vertebrates such as deer, fox, raccoon, etc. The selection of corridor sites is also critical. They should contain "islands" of specialized habitats, such as rock outcrops (Plate XIV). The habitat pictured here permits the existence of a thriving western fence lizard colony which, in turn, provides feeding opportunities for snakes like the Alameda striped racer and several smaller hawk species. The rock crevices also provide den sites for a number of small mammal predators. Of all the habitat types which may be incorporated into corridors, creek beds and the surrounding riparian woodland are perhaps the most important.

OVERGRAZING. Another human-directed problem with respect to wildlife habitat preservation is overgrazing. Views such as that shown in Plate XV are quite common on large, private tracts like the Soda Ranch. When just about all the grass cover is eaten down, most small herbivores can no longer exist in the area. Since they form the base of the grassland food web, the larger forms also become scarce. One exception is the California ground squirrel, which thrives when grassland is overgrazed. Ironically, this is



PLATE XIII

Leapfrog Building Excludes Wildlife Corridors



PLATE XIV

An "Island" of Rock Outcrop in Grazed Grassland



PLATE XV

Overgrazed Ranchland Along Fairview Blvd.



PLATE XVI

Lightly Grazed Grassland



PLATE XVII

Overgrazed Small Acreage



PLATE XVIII

Contrast Between Ungrazed Area and Small Pasture

the least desirable rodent to encourage in large numbers, because they can carry fleas which transmit plague. It was of some interest during this study to hear one rancher go on and on with a vigorous complaint of how the ground squirrels were overrunning the ranch, without any awareness that overgrazing had caused this problem. In contrast, the grassland along the Fairview Avenue boundary of the Reed Ranch shows no overgrazing and no ground squirrels (Plate XVI).

Overgrazing on small acreages is often even more intense. The hillside in the background of Plate XVII has been reduced to grass stubble. The one remaining member of the coastal scrub community, the coyote bush, is, by itself, not effective as wildlife habitat. Even more dramatic is the pasture, if it can still be called that, on the right portion of Plate XVIII. This land has been reduced to bare soil. It apparently began as a thriving grassland-scrub community, as still may be seen to the left of the wire fence.

DOMESTIC DOGS AND DOG PACKS. This problem has already been mentioned as part of the mammal survey. It is mentioned again, here, as a final area to be controlled if wildlife is to exist in close quarters with human habitation. Leash laws are now becoming common in city areas, but the false assumption that they are not needed in the suburbs and beyond still persists. No assumption could be further from the truth. Dogs are fine domestic animals but, as such, should be kept under strict domestic control. A man who daily exercised his pet mountain lion in the hill area would, no doubt, soon be arrested. However, a pair of large dogs has several times the destructive potential of a mountain lion, and a pack of dogs represents the second coming of the wolf. If we desire that, let's at least do it right and stock the real thing.

CONCLUSION

The wildlife of the Hayward Hills is a unique resource available for all the people of this community to enjoy. It is the product of millions of years of evolution and adaptation. The land use decisions of the next few years shall determine whether or not it will remain.

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